NERVES
OF THE HUMAN BODY

WITH DIAGRAMS

ALFRED W. HUGHES

LIBRARY
OF THE
LONDON SCHOOL OF MEDICINE FOR WOMEN,
7 to 11, Hunter Street, Brunswick Square, W.C.

EF2.115

INSTITUTE OF NEUROLOGY
The
ROCKEFELLER
MEDICAL LIBRARY

Do. ZOOLOGY NOTES—Part 1—invertebrata, . 2/0
Do. Do. —Part 2— Do., . 2/0
Do. Do. —Part 3—Vertebrata, . 2/0

Full Catalogues of our Publications on application.

INSTITUTE OF NEUROLOGY
ROCKEFELLER
MEDICAL
LIBRARY
QUEEN SQUARE

NERVES

OF THE HUMAN BODY

WITH DIAGRAMS

BY

ALFRED W. HUGHES

BACHELOR OF MEDICINE AND MASTER IN SURGERY OF THE UNIVERSITY OF EDINBURGH; FELLOW OF THE ROYAL COLLEGE OF SURGEONS OF EDINBURGH; MEMBER OF THE ROYAL COLLEGE OF SURGEONS OF ENGLAND; LECTURER ON ANATOMY, SCHOOL OF MEDICINE, SURGEONS' SQUARE, EDINBURGH.

7-11, HUNTER STREET
LONDON
(ROYAL FREE HOSPITAL)
SCHOOL OF MEDICINE
FOR WOMEN
BRUNSWICK SQUARE, W.C.

EDINBURGH:

E. & S. LIVINGSTONE

1890.

INSTITUTE OF NEUROLOGY
ROCKEFELLER
MEDICAL
LIBRARY
QUEEN SQUARE

PRINTED BY
E. & S. LIVINGSTONE
4 MELBOURNE PLACE
EDINBURGH.

LONDON: BAILLIERE, TINDALL & COX;
SIMPKIN, MARSHALL, HAMILTON, ADAMS, AND KENT & CO.;
GLASGOW: A. STENHOUSE, W. SIME.
DUBLIN: FANNIN & Co.; GILL & SON.
ABERDEEN: JOHN ADAM; J. G. BISSET.
MANCHESTER: J. E. CORNISH.

ROCKEFELLER MEDICAL LIBRARY
INSTITUTE OF NEUROLOGY
CLASS HIST. N.
ACCN. ~~3784~~ B/83
SOURCE Dr. R. F. Hoff.
DATE ~~9.12.64~~. 28.5.65

PREFACE.

LITTLE need be said by way of preface in offering this small work to Students of Medicine. It is an attempt to lighten their task in acquiring a knowledge of the Nerves of the Human Body.

At first it was intended that the book should include Diagrams and descriptions of the Cranial Nerves only, which usually present great difficulties to the Student, from the circumstance, that the descriptions of these nerves, when treated of in works on Practical Anatomy, are of necessity scattered and disconnected and consequently confusing, unless the Student has previously studied the part in one of the systematic text-books.

Though the letterpress contains all that is required for ordinary examination purposes, it is earnestly to be hoped that this work will be used as an adjunct only to the standard works on Practical Anatomy, and as a help to Students in their practical work.

In preparing the Diagrams I have received much assistance from the work of Professor FLOWER, to whom I again offer my grateful thanks for kind permission to make extracts out of his book. My thankful acknowledgments are also due to Mr J. T. MURRAY for the great trouble taken by him in so excellently reproducing the Plates.

ALFRED W. HUGHES.

42 GEORGE SQUARE, EDINBURGH,
February 1890.

B1 16

CRANIAL NERVES.

FIRST OR OLFACTORY NERVE.—(Plate I.)

The **Olfactory Nerves** or **Filaments** arise from the olfactory bulb, which lies on the upper surface of the cribriform plate of the ethmoid bone, and which is brought into connection with the brain by means of the olfactory tract.

The **Olfactory Tract** lies in a groove on the under surface of the frontal lobe, and arises by two roots —an inner, which passes to the outer side of the great longitudinal fissure, and has been traced to the gyrus fornicatus; and an outer, which passes across the anterior perforated space to the temporo-sphenoidal lobe.

A middle root is sometimes described, arising from the olfactory tubercle.

The **Olfactory Bulb** lies on the cribriform plate and gives off three sets of *olfactory filaments* to the nose, through the foramina in that plate. The inner set pass to the mucous membrane on the septum, the outer set to the mucous membrane on the outer wall, while the middle set are distributed on the roof of the nasal cavity.

SECOND OR OPTIC NERVE.—(Plate I.)

The optic nerves arise from the optic commissure, which lies across the middle line, between their posterior extremities, and receives posteriorly the optic tracts.

The **Optic Tract** arises from the posterior part of the optic thalamus, from the corpora geniculata, and from the anterior of the corpora quadrigemina. The tract winds round the crus cerebri and joins the commissure, in which most of its fibres decussate with fibres of the opposite tract, a few of the outer fibres passing on to the eyeball of the same side.

The **Optic Commissure** or **Chiasma** lies in a groove in front of the olivary eminence on which it rests, and from it the optic nerves are given off.

The **Optic Nerves** enter the orbit through the optic foramen. In the orbit, each nerve lies beneath the superior rectus muscle, is crossed obliquely by the nasal nerve, and has the ciliary nerves on its surface. Finally, it pierces the eyeball one-tenth of an inch internal to the centre of its fundus, and, having passed through the sclerotic and choroid coats, it spreads out to form the inner layer of the retina. It is pierced by the arteria centralis retinæ, which runs in its axis.

THIRD OR OCULO-MOTOR NERVE.—(Plate I.)

Deep Origin.—Grey matter of aqueduct of Sylvius.

Superficial Origin.—The nerve appears on the inner side of the crus cerebri, just in front of the pons varolii. From its origin the nerve passes forwards and pierces the dura mater a little in front of the posterior clinoid process. It passes forward in the dura mater, which forms the outer wall of the cavernous sinus, and enters the orbit through the sphenoidal fissure by passing between the heads of the external rectus muscle. In the orbit it supplies all the muscles, excepting the superior oblique and external rectus. As it lies in the sphenoidal fissure, it divides into two parts, which are separated by the nasal nerve. The upper portion supplies the superior rectus and levator palpebrae superioris. The inferior portion supplies the inferior and internal recti, and also the inferior oblique muscle. This last branch supplies the motor root to the lenticular ganglion.

The third nerve is connected with the cavernous plexus of the sympathetic, as it lies in the outer wall of the cavernous sinus.

N.B.—All the motor nerves in the orbit supply their respective muscles on their ocular surfaces, excepting the *fourth nerve*, which supplies the superior oblique on its *orbital* surface, and the *nerve to the inferior oblique* which enters that muscle on its *posterior border*.

FOURTH OR TROCHLEAR NERVE.—(Plate I.)

The fourth is the smallest cranial nerve, and has the longest course in the cranial cavity.

Deep Origin.—Grey matter of aqueduct of Sylvius immediately below the third; from this it passes to the valve of Vieussens, where it decussates with the opposite nerve.

Superficial Origin and Course.—From the valve of Vieussens the nerve passes round the crus cerebri and lies beneath the free border of the tentorium cerebelli. It pierces the dura mater behind the posterior clinoid process, passes in the outer wall of the cavernous sinus, and enters the orbit through the inner end of the sphenoidal fissure. In the orbit, it supplies the superior oblique muscle on its upper surface.

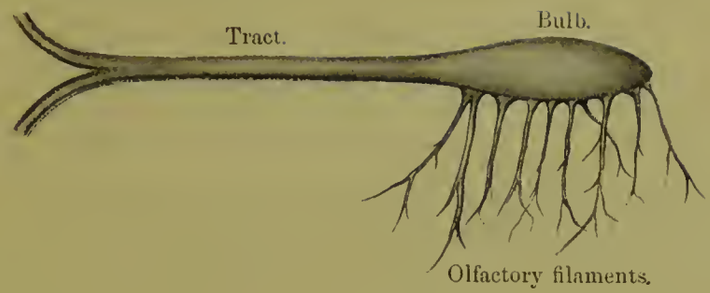
The fourth nerve communicates with the cavernous plexus of the sympathetic.

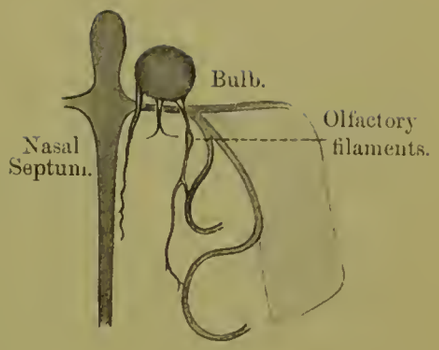
RELATIVE POSITIONS OF NERVES AT THE CAVERNOUS SINUS AND IN THE SPHENOIDAL FISSURE.

In the dura mater, which forms the outer wall of the *cavernous sinus*, the third, fourth, and ophthalmic division of the fifth nerves, lie in their numerical order from above downwards, and from within outwards, while the sixth nerve lies on the floor of the sinus, close to the carotid artery.

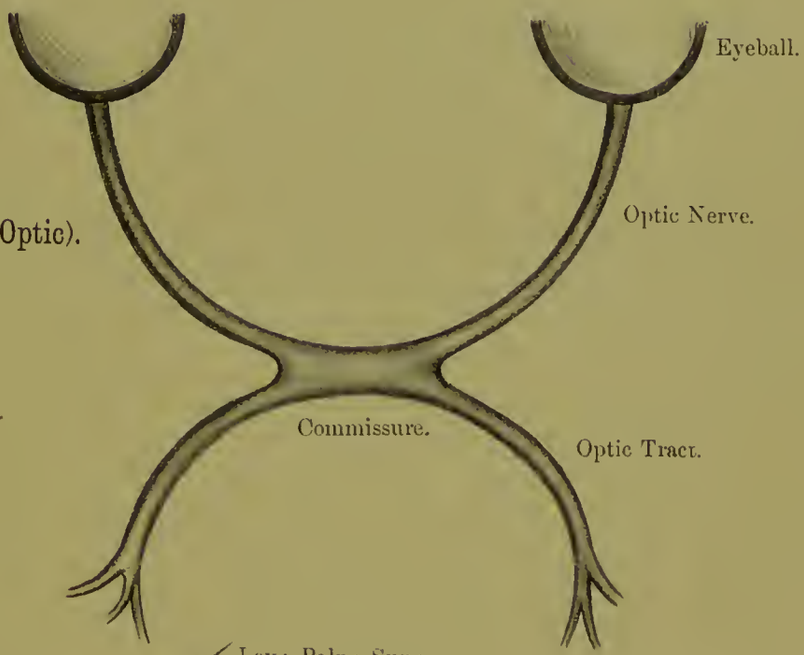
In the *sphenoidal fissure*, where the ophthalmic division of the fifth has divided into its frontal, lachrymal, and nasal branches, and the third nerve has divided into two portions, the relations of the nerves are as follows:—The fourth, frontal, and lachrymal nerves enter the orbit above the muscles, while the remaining nerves pass between the heads of the external rectus muscle in the following order, from above downwards—Upper division of third, nasal branch of fifth, lower division of third, and sixth nerve.

First Nerve (Olfactory).

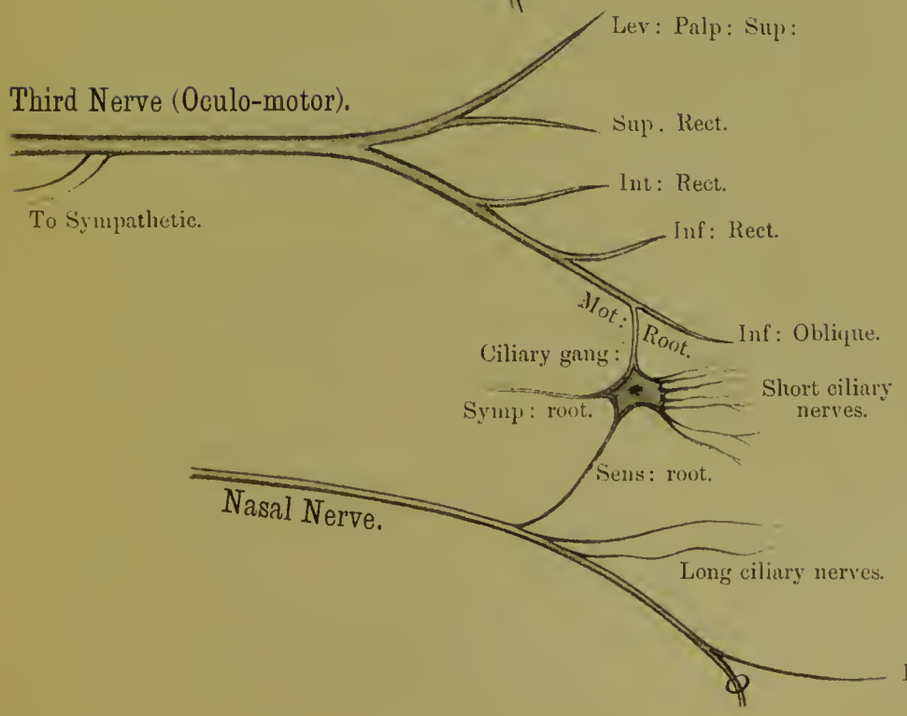




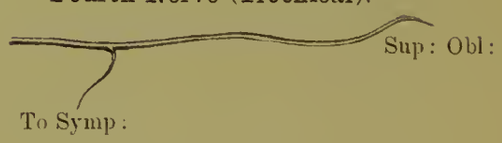
Second Nerve (Optic).



Third Nerve (Oculo-motor).



Fourth Nerve (Trochlear).



Sixth Nerve (Abducens).



A. W. HUGHES

T. MURRAY

FIFTH OR TRIFACIAL NERVE.—(Plate II.)

The fifth nerve appears by two roots, motor and sensory, which emerge on the surface of the pons. These arise in two nuclei, motor and sensory, in the floor of the upper part of the fourth ventricle. The motor nucleus is joined by a root which descends from the grey matter of the aqueduct of Sylvius; the sensory nucleus is joined by a root which ascends from the gelatinous substance of Rolando.

The **Sensory Root** becomes enlarged and forms the Gasserian ganglion, which is crescentic in shape and lies in a depression on the petrous part of the temporal bone, and, having supplied small twigs to the dura mater and sympathetic nerve, gives off, from its anterior convex margin, three large nerves—

First or Ophthalmic Division, which passes to the orbit.

Second or Superior Maxillary Nerve, which passes through the floor of the orbit to the upper jaw, and to the face below the orbit.

Third or Inferior Maxillary Nerve, which is joined by the motor root, and is distributed to the lower jaw, tongue, muscles of mastication, and skin of the temporal region.

The **Motor Root** has no connection with the Gasserian ganglion, but passes down on its inner side to join the inferior maxillary nerve. It will thus be noticed that the ophthalmic and superior maxillary divisions are entirely sensory in their distribution, while the inferior maxillary nerve is partly sensory and partly motor.

OPHTHALMIC NERVE.—(Plate II.)

The ophthalmic nerve, having given off a small recurrent branch to the dura mater, passes forwards in the outer wall of the cavernous sinus to enter the orbit through the sphenoidal fissure, where it divides into the lachrymal, frontal, and nasal nerves. The frontal and lachrymal nerves enter the orbit above the muscles, while the nasal nerve passes between the two heads of the external rectus muscle.

The **Frontal Nerve** divides into the *Supra-orbital* and *Supra-trochlear*, which pass along the roof of the orbit, to be distributed to the skin of the upper eyelid, forehead, and scalp—the former being the more external of the two and passing through the supra-orbital notch.

The **Lachrymal Nerve** is external to the frontal and passes along the outer part of the orbit, gives off a few branches to the lachrymal gland, and terminates in the skin of the upper eyelid.

The **Nasal Nerve** crosses the optic nerve obliquely from without inwards, and leaves the orbit by the anterior ethmoidal foramen; it then crosses the cribriform plate of the ethmoid, and enters the nose through a slit in that plate, close to the crista galli. In the nose it gives off branches to the mucous membrane of the septum and outer wall, and terminates by passing between the nasal bone and lateral cartilage to supply the skin of the lower part of the side of the nose. In the orbit the nasal nerve gives off—

(*a*) *Sensory Root* to the lenticular ganglion.

(*b*) Two *Long Ciliary Nerves* to the eyeball.

(*c*) *Infra-trochlear Nerve*, which passes forwards along the inner wall of the orbit, below the superior oblique, to supply the integuments of the inner parts of the eyelids and upper part of the nose.

SUPERIOR MAXILLARY NERVE.—(Plate II.)

The superior maxillary nerve passes horizontally forwards, and leaves the cavity of the cranium through the foramen rotundum. It then crosses the spheno-maxillary fossa, and enters the infra-orbital canal, becoming the infra-orbital nerve. Having traversed this canal, it appears on the face at the infra-orbital foramen, where it divides into its terminal branches for the lower eyelid, nose, and upper lip.

Branches—

1. **Recurrent Branch** to dura mater.
2. **Spheno-palatine**, given off in the spheno-maxillary fossa to Meckel's ganglion.
3. **Orbital or Temporo-malar**, given off in the spheno-maxillary fossa. This divides into—
 Temporal Branch, which pierces the malar bone and reaches the skin of the temporal fossa.
 Malar Branch (r. subcutaneous malæ), which pierces the malar bone to supply the skin on its facial surface.
4. **Three Superior Dental Nerves**—
 Posterior Superior Dental—given off before the nerve enters the infra-orbital canal—enters the foramina on the zygomatic surface of the jaw and supplies the molar teeth.
 Middle and Anterior Dental nerves are given off in the infra-orbital canal, and traverse small canals in the wall of the antrum, to supply the bicuspid, canine, and incisor teeth.
5. **Terminal Branches** on the face, viz.:—
 Palpebral Branches to the skin of the lower eyelid.
 Nasal Branches to the skin of the nose.
 Labial Branches to the skin of the upper lip.

All the branches which appear on the face join corresponding branches of the facial nerve.

INFERIOR MAXILLARY NERVE.—(Plate II.)

This consists of a sensory portion derived from the Gasserian ganglion, which is joined by the motor root. These divisions pass separately through the foramen ovale, and join immediately afterwards to form a short trunk, which lies in the pterygo-maxillary region beneath the external pterygoid muscle. This short trunk gives off a small *recurrent* branch to the dura mater, and divides immediately into a small or anterior, and a large or posterior, portion.

The Anterior Division is almost entirely motor in function, and supplies—

1. **Deep Temporal Branches**, two or three in number, to the temporal muscle.
2. **Masseteric Branch** to the masseter, which passes through the sigmoid notch of the jaw.
3. **Pterygoid Branches** to the internal and external pterygoid muscles.
4. **Long Buccal Nerve** (the only sensory branch of the anterior division).—This nerve pierces the external pterygoid muscle, passes on to the surface of the buccinator muscle, supplies the skin and mucous membrane of the cheek, and communicates with branches of the facial nerve.

The Posterior Division of the inferior maxillary nerve divides into lingual, inferior dental, and auriculo-temporal branches.

PLATE II.

Ophthalmic Division.

1. Recurrent.
2. Frontal.
3. Supra-orbital.
4. Supra-trochlear.
5. Nasal. = naso - ciliary
6. To Clliary Ganglion.
7. Long Ciliary Nerves.
8. Infra-trochlear.
9. Lachrymal.

Superior Maxillary Division.

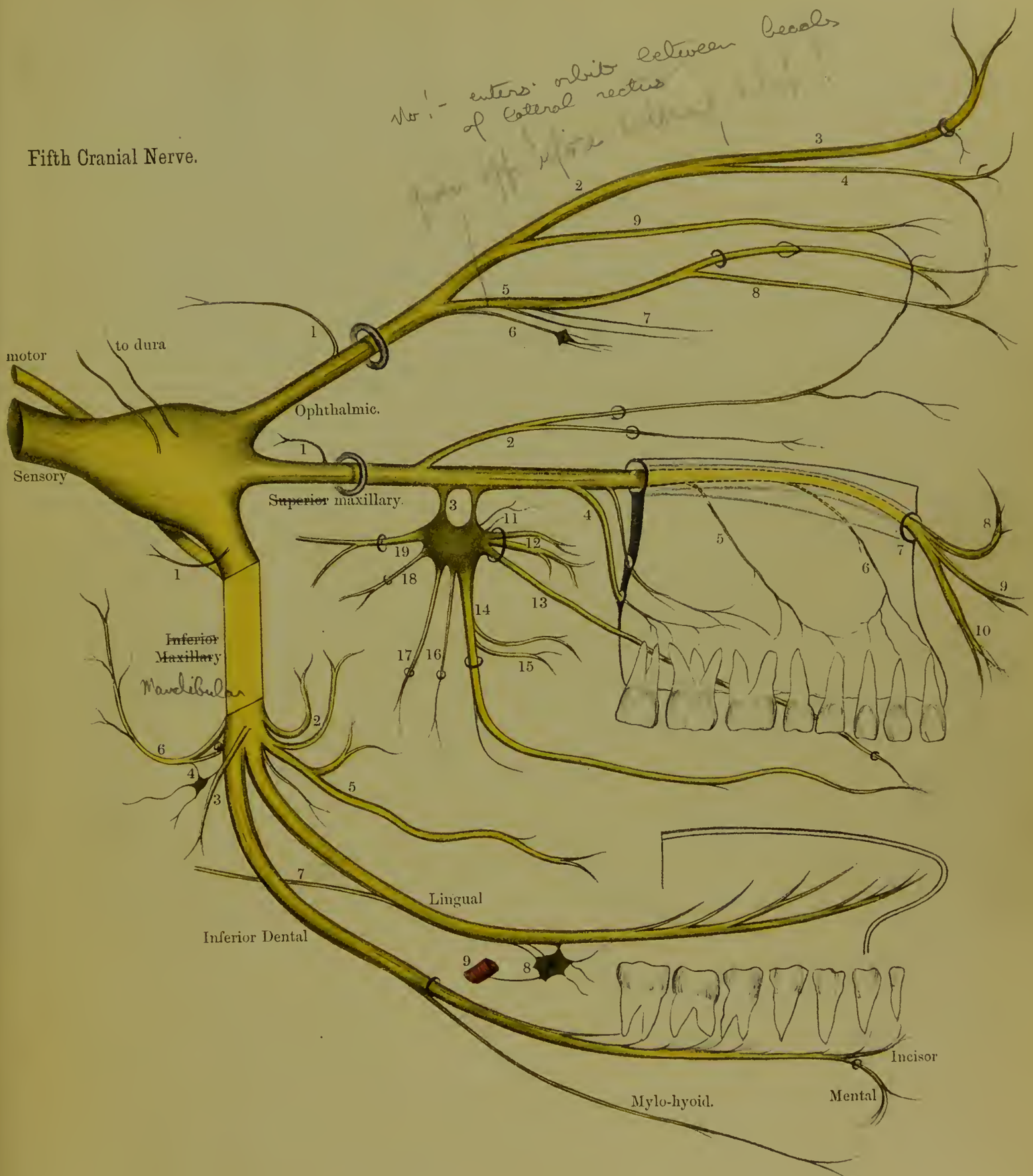
1. Recurrent.
2. Temporo-malar.
3. Spheno-palatine to Meckel's Ganglion.
4. Posterior Dental.
5 & 6. Anterior and Middle Dental.
7. Infra-orbital.
8. Palpebral.
9. Nasal.
10. Labial.
11. Ascending Branches of Meckel's Ganglion.
12. Superior Nasal.
13. Naso-palatine.
14. Anterior Palatine.
15. Inferior Nasal.
16. Middle Palatine.
17. Posterior Palatine.
18. Pharyngeal.
19. Vidian.

Mandibular

Inferior Maxillary Division.

1. Recurrent.
2. Muscular.
3. Nerve to Interior Pterygoid.
4. Otic Ganglion.
5. Long Buccal Nerve.
6. Auriculo-temporal.
7. Chorda Tympani.
8. Submaxillary Ganglion.
9. Facial Artery

Fifth Cranial Nerve.



A. V. HUGHES

T. MURRAY

The **Auriculo-temporal Nerve** usually arises by two roots, which embrace the middle meningeal artery; it then passes backwards on the inner side of the neck of the jaw, to reach the interval between the articulation of the jaw and the external auditory meatus; and, passing up over the zygoma, close to the temporal artery, it terminates in branches which supply the skin in the temporal region and communicate with the facial nerve.

The auriculo-temporal nerve gives off the following branches:—

1. **Communicating Branches** to the otic ganglion and facial nerve.
2. **Articular Branch** to the temporo-maxillary joint.
3. **Branches to the Parotid Gland** (derived probably from the otic ganglion).
4. **Branches to the External Auditory Meatus.**
5. **Branches to the Skin of the Ear.**
6. **Terminal Branches** to the skin of the temporal region.

Inferior Dental Nerve.—This nerve descends beneath the external pterygoid muscle, and enters the inferior dental canal, along which it passes as far as the mental foramen, giving off branches in its course to the teeth. Here it divides into *Mental* and *Incisor* branches :—

The Mental branch passes through the foramen, to appear on the face, where it supplies the integuments of the chin, and the skin and mucous membrane of the lower lip, and communicates with the supra-maxillary branches of the facial nerve.

The Incisor branch is prolonged forwards beneath the incisor teeth, which it supplies.

Before the nerve enters the inferior dental canal, it gives off the Mylo-hyoid branch, which runs in a groove on the inner surface of the jaw, to supply the mylo-hyoid and anterior belly of the digastric muscles.

Lingual or Gustatory Nerve.—The lingual nerve descends on the inner side but in front of the inferior dental nerve, and lies between the internal pterygoid muscle and the ramus of the jaw. It then crosses obliquely from the inner surface of the jaw to the side of the tongue, lying immediately beneath the mucous membrane of the mouth; and, crossing the superior constrictor of the pharynx close to where that muscle is attached to the inner surface of the jaw, the nerve passes below Wharton's duct, and is prolonged under the side of the tongue to the tip of the organ. Close to its origin, the lingual nerve is joined at an acute angle by the Chorda Tympani branch of the facial nerve.

Branches—

1. **Communicating Branches** to the sub-maxillary ganglion, and to the hypo-glossal nerve.
2. **Branches to the mucous membrane of the mouth.**
3. **Lingual or Terminal Branches,** which pierce the substance of the tongue to supply the mucous membrane of the anterior two-thirds of the organ.

GANGLIA OF THE FIFTH NERVE.

In addition to the Gasserian ganglion, there are four small ganglia connected with the divisions of the fifth nerve. The ophthalmic ganglion is connected with the ophthalmic division; Meckel's ganglion with the superior maxillary; while in connection with the inferior maxillary division are found two small ganglia —the otic and sub-maxillary.

Each ganglion receives small sensory, motor, and sympathetic fibres constituting its *roots*, and each gives off small *branches of distribution.*

OPHTHALMIC, LENTICULAR, OR CILIARY GANGLION.—(Plate I.)

This ganglion lies at the back of the orbit between the external rectus muscle and optic nerve, in close relation to the opthalmic artery.

Roots.—It receives its *Sensory* root from the nasal branch of the fifth nerve, its *Motor* root from the nerve to the inferior oblique muscle; and the *Sympathetic* root is derived from the cavernous plexus.

Branches.—It gives off six to ten *Short Ciliary Nerves*, which accompany the long ciliary branches of the nasal nerve. These pierce the sclerotic coat and enter the eyeball, where they supply the ciliary muscle and iris.

SPHENO-PALATINE, OR MECKEL'S GANGLION.—(Plate II.)

Meckel's ganglion lies in the spheno-maxillary fossa, close to the spheno-palatine foramen, and immediately beneath the superior maxillary nerve.

Roots.—Its *Sensory* roots are derived from the superior maxillary nerve, through its spheno-palatine branches. The *Motor* and *Sympathetic* roots are carried to it by the Vidian nerve, which passes through the Vidian canal, and is formed by the junction of the great superficial petrosal branch of the facial nerve with a branch of the carotid plexus.

Branches.—These are divided into four sets:—

1. Ascending.—Small branches to the periosteum of the orbit.
2. Descending.—*Anterior*, *Posterior*, and *External Palatine Nerves*, which descend through separate canals to supply the mucous membrane covering the hard and soft palates—the anterior branch reaching as far as the incisor teeth, and from the posterior palatine branches twigs are given to the levator palati and azygos uvulæ muscles. The anterior palatine gives off *Inferior Nasal* branches to the mucous membrane of the nose.
3. Internal.—These supply the nasal mucous membrane and adjoining sinuses, and are the *Superior Nasal* and *Naso-palatine*. The latter crosses the roof of the nose, and passes obliquely downwards on the nasal septum to pass through the anterior palatine foramen, and terminates behind the incisor teeth, where it communicates with the anterior palatine nerve.
4. Posterior.—These are the *Vidian* (already mentioned as conveying motor and sympathetic fibres), and the *Pharyngeal* or *Pterygo-palatine*, which passes through the pterygo-palatine canal to supply the mucous membrane of the pharynx behind the Eustachian tube.

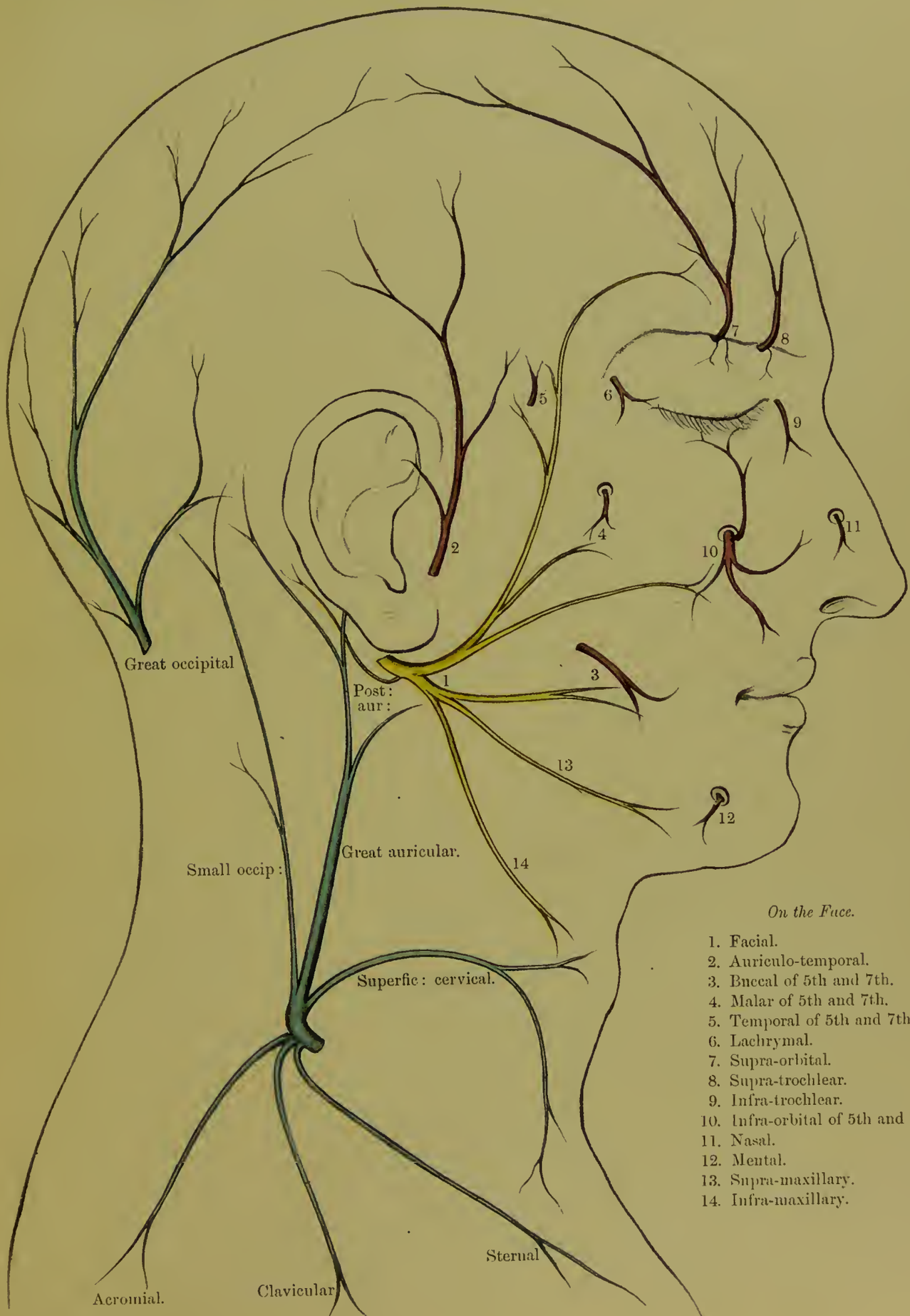
OTIC GANGLION.—(Plates II. and IV.)

The otic ganglion lies immediately below the foramen ovale, in front of the middle meningeal artery, and in close contact with the nerve to the internal pterygoid muscle.

Roots.—It receives fibres by the nerve to the internal pterygoid muscle; it also receives the *Small Superficial Petrosal Nerve*, which probably conveys *motor* fibres from the facial and *sensory* fibres from the glosso-pharyngeal nerve. Its *sympathetic* root is derived from the plexus on the middle meningeal artery.

Branches.—In addition to small communicating branches to the auriculo-temporal nerve, it supplies the tensor tympani and tensor palati muscles.

Superficial Nerves of Face and Front of the Neck, with their Communications.



On the Face.

1. Facial.
2. Auriculo-temporal.
3. Buccal of 5th and 7th.
4. Malar of 5th and 7th.
5. Temporal of 5th and 7th.
6. Lachrymal.
7. Supra-orbital.
8. Supra-trochlear.
9. Infra-trochlear.
10. Infra-orbital of 5th and 7th.
11. Nasal.
12. Mental.
13. Supra-maxillary.
14. Infra-maxillary.

A W HUGHES

T MURRAY DEL.

SUB-MAXILLARY GANGLION.—(Plate II.)

This ganglion lies beneath the mylo-hyoid muscle, between the lingual nerve and the deep portion of the sub-maxillary gland.

Roots—

Motor and *Sensory* filaments pass to the ganglion from the lingual nerve, the motor fibres being derived from the chorda tympani which joins that nerve.

Sympathetic Fibres pass to it from the plexus on the facial artery.

Branches.—These pass to the sub-maxillary gland and mucous membrane of the mouth.

SIXTH OR ABDUCENT NERVE.—(Plate I.)

Deep Origin—

The sixth nerve arises from a nucleus in the floor of the fourth ventricle, beneath the upper part of the fasciculus teres.

Superficial Origin.—The nerve appears on the surface, in the groove between the pons and medulla, immediately external to the upper end of the anterior pyramid. From its origin the nerve passes forwards and pierces the dura mater close to the outer border of the dorsum sellæ; and, passing through a notch in the outer border of that plate of bone, it reaches the outer side of the internal carotid artery, lying close to the floor of the cavernous sinus. It afterwards enters the orbit through the sphenoidal fissure by passing between the heads of the external rectus muscle, which it supplies.

The sixth nerve receives a communicating branch from the carotid plexus of the sympathetic.

FACIAL NERVE.—(Plate IV.)

Deep Origin—

The facial nerve arises from a nucleus in the pons which lies more deeply but on the same level as that of the sixth nerve. From this the fibres pass to the floor of the fourth ventricle, where they ascend in the fasciculus teres. They afterwards bend outwards and forwards through the pons to appear at its lower border in a line with the fifth nerve.

Superficial Origin.—The nerve appears at the upper part of the medulla, between the olivary and restiform bodies, close to the lower border of the pons.

From its origin the nerve passes into the internal auditory meatus, where it rests in a groove on the auditory nerve—a slender fasciculus, the *pars intermedia*, lying between and often connected with both nerves. At the bottom of the meatus it enters the aqueductus Fallopii, and in that canal it winds through the petrous part of the temporal bone, passing first outwards horizontally; it then bends backwards above the fenestra ovalis, and afterwards descends behind the tympanum to emerge at the stylo-mastoid foramen.

At the point where it bends backwards in the aqueduct, it becomes enlarged in front and forms the **Geniculate Ganglion,** which contains some nerve cells.

After leaving the skull the nerve gives off several branches and divides into two portions—temporo-facial and cervico-facial, which pass forwards through the parotid gland and over the external carotid artery, and terminate in branches which radiate on the face to supply all the muscles of expression, forming the **Pes Anserinus.**

(*a*) Branches given off in the Temporal Bone—

1. **Branches to join the Auditory Nerve** in the meatus.
2. **Great Superficial Petrosal Nerve.**—This nerve is given off from the geniculate ganglion, and passes out through the hiatus Fallopii; it is joined by a branch from the carotid plexus, the Vidian nerve being thus formed, which passes through the Vidian canal to Meckel's ganglion.
3. **Branch** from the geniculate ganglion **to join the Small Superficial Petrosal**, which passes to the otic ganglion.
4. **External Superficial Petrosal.**—This filament is also given off from the geniculate ganglion, and passes to the plexus on the middle meningeal artery.
5. **Branch to the Stapedius Muscle.**
6. **Chorda Tympani.**—This nerve leaves the facial near the lower end of the aqueductus Fallopii. It enters the tympanum, crosses the tympanic membrane, lying on the inner side of the handle of the malleus. It leaves the cavity by a small canal close to the Glaserian fissure, and joins the lingual nerve at an acute angle, to be distributed, along with that nerve, to the sub-maxillary ganglion and mucous membrane of the tongue.*
7. **Communicating Branch** with the auricular branch of the vagus.

(*b*) Branches outside the Skull—

1. **Posterior Auricular.**—This branch passes up behind the ear, supplies the retrahens aurem and posterior part of the occipito-frontalis.

 It gives twigs to the small muscles on the pinna, and communicates with the small occipital, great auricular, and Arnold's nerve.

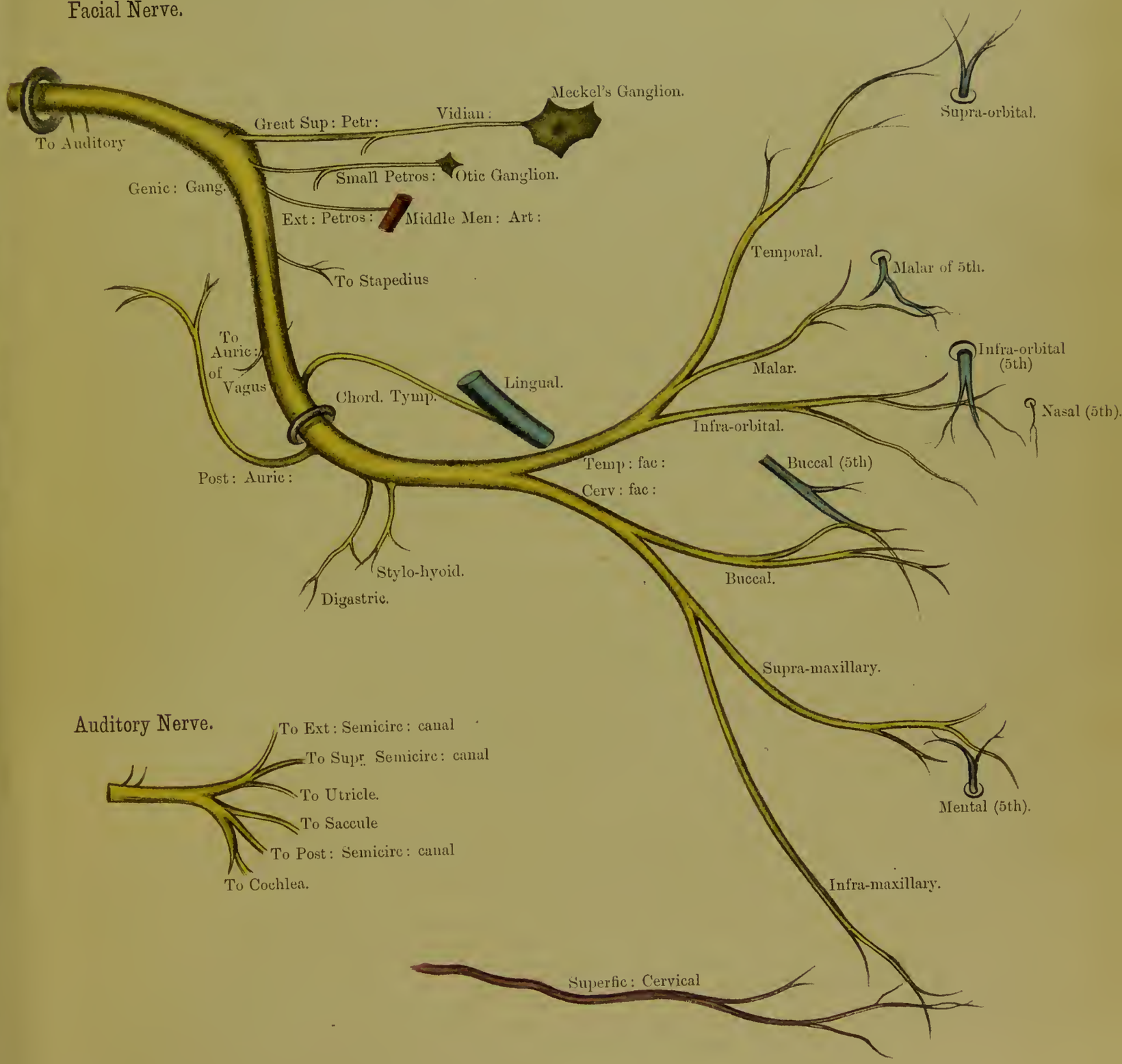
2. **Branches to the Digastric Muscle**, one of which joins the glosso-pharyngeal nerve.
3. **Branch to the Stylo-hyoid Muscle.**

Temporo-facial Division.—This divides into temporal, malar, and infra-orbital branches.

(*a*) **Temporal Branches** supply the anterior and superior muscles of the ear, and the facial muscles which lie above the zygoma. They communicate with the auriculo-temporal, temporal, and supra-orbital branches of the fifth nerve.

* The fibres of the chorda tympani reach the tongue from the brain by a very circuitous course, for, according to Gowers, "Disease of the facial nerve within the skull does not impair taste; hence, the fibres that reach the facial by the chorda tympani must leave the nerve again, and the opinion is probably correct which assumes that they pass from the geniculate ganglion of the facial by the Vidian nerve to the spheno-palatine ganglion. Thus again reaching the fifth nerve they seem to ascend in the second division to its root and the brain."

Facial Nerve.



Auditory Nerve.

A W HUGHES

(*b*) **Malar Branches** pass over the malar bone, supply the orbicularis palpebrarum, and communicate with the malar branch of the fifth nerve.

(*c*) **Infra-orbital Branches** communicate with the infra-orbital branch of the fifth nerve and supply all the muscles of the upper lip and nose.

Cervico-facial Division—

(*a*) **Buccal Branches** supply the buccinator and orbicularis oris muscles, and communicate with the buccal branch of the fifth nerve.

(*b*) **Supra-maxillary Branches** lie over the lower jaw and supply the muscles of the lower lip and chin, and communicate with the mental branch of the fifth nerve.

(*c*) **Infra-maxillary Branches** pass below the jaw, supply the platysma, and communicate with the superficial cervical branch of the cervical plexus.

It will thus be noticed that all the branches of the facial nerve, on the face, communicate with branches of the fifth nerve, while the branch which passes below the jaw joins a branch of the cervical plexus.

AUDITORY NERVE.—(Plate IV.)

The auditory nerve arises from two nuclei in the floor of the fourth ventricle, of which the larger and inner lies beneath the tuberculum acusticum.

The nerve appears partly internal to, and partly upon the restiform body, and passes into the internal auditory meatus, where it divides into cochlear and vestibular divisions—the former supplying the cochlea, saccule, and posterior semi-circular canal; the latter being distributed to the remaining parts of the internal ear.

GLOSSO-PHARYNGEAL NERVE.—(Plate V.)

Deep Origin—

Nucleus, in floor of fourth ventricle, beneath the inferior fovea, in a line with, but above the vagus.

Superficial Origin.—It appears on the surface, at the upper part of the medulla, between the olivary and restiform bodies by a series of five or six filaments between the auditory and vagus nerves.

It leaves the skull by passing through the jugular foramen, in front of the vagus and in a separate sheath of dura mater.

As it lies in the canal it presents two enlargements, the jugular and petrous ganglia.

The **Jugular Ganglion** is of small size, and only involves a few of the fibres of the nerve, and lies at the upper part of the foramen.

The **Petrous Ganglion** lies at the lower part of the foramen, in a groove on the petrous portion of the temporal bone.

This ganglion communicates with the upper ganglion of the sympathetic, with Arnold's nerve, and with the vagus, and gives off the tympanic branch.

In the neck the nerve appears between the internal carotid artery and internal jugular vein. It then passes between the internal and external carotid arteries, and winds round the stylo-pharyngeus muscle, with which it is in close contact, and finally reaches the under surface of the base of the tongue by passing beneath the hyo-glossus muscle.

HUNTER STREET
LONDON
(BRIT. FREE HOSPITAL)
SCHOOL OF MEDICINE
FOR WOMEN
SWICK SQUARE, W.C.

Branches of Distribution—

1. **Tympanic Branch** (nerve of Jacobson).—This is given off from the petrous ganglion and enters the tympanum by passing through a small canal between the carotid canal and the jugular fossa. In the tympanum it breaks up into a plexus on the promontory (tympanic plexus), from which branches pass to the fenestra ovalis and fenestra rotunda, to the mastoid cells and Eustachian tube. The nerve terminates as the *Small Superficial Petrosal*, which communicates with the facial nerve and passes to the otic ganglion.*

2. **Pharyngeal Branches.**—Some of these pierce the superior constrictor to supply the mucous membrane of the upper part of the pharynx. One branch enters the PHARYNGEAL PLEXUS.

3. **Branch to Stylo-pharyngeus.**

4. **Tonsillitic Branches** to tonsil, soft palate, and fauces.

5. **Lingual Branches** to the mucous membrane of the posterior third of the dorsum of the tongue, some passing to the side of the tongue as far as its middle.

PNEUMOGASTRIC OR VAGUS NERVE.—(Plate V.)

Deep Origin—

Nucleus, beneath the floor of the fourth ventricle, between nucleus of glosso-pharyngeal and that of spinal accessory, and external to the hypo-glossal nucleus.

Superficial Origin. — It appears in front of the restiform body as twelve to fifteen filaments in a line with those of the glosso-pharyngeal. The nerve passes out through the jugular foramen, where all its filaments unite in a ganglion *(ganglion of the root);* after passing through the foramen a larger ganglion is formed *(ganglion of the trunk).*

The Ganglion of the Root is connected with the facial, glosso-pharyngeal, spinal accessory, and sympathetic nerves, and gives off the auricular and recurrent branches.

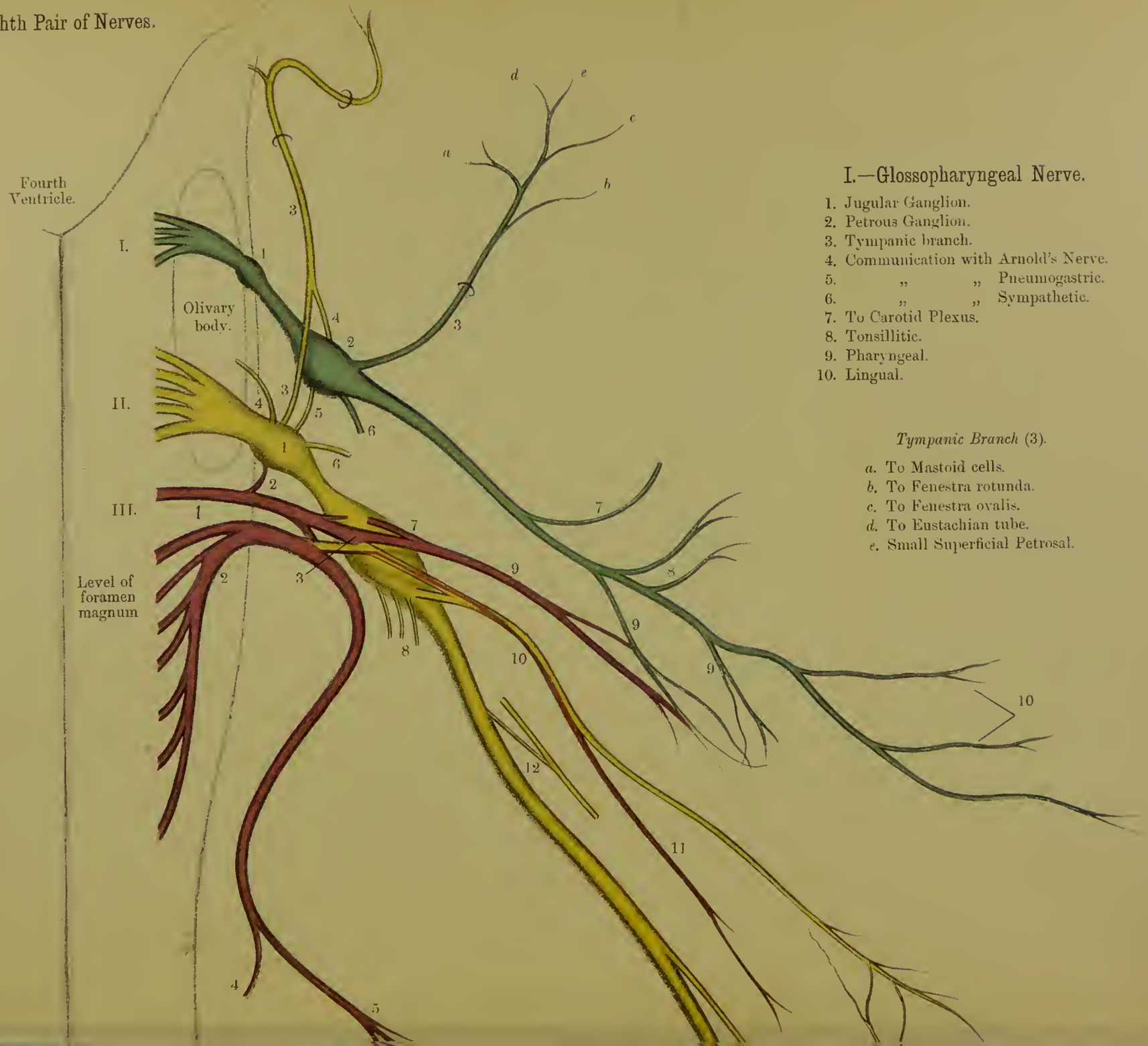
The Ganglion of the Trunk—much larger than the upper—is connected with the hypo-glossal, first and second cervical nerves, and upper ganglion of the sympathetic, and gives off, partly, the pharyngeal and superior laryngeal branches.

In the neck, the nerve appears between the internal carotid artery and internal jugular vein; and, entering the carotid sheath, the nerve passes down in that sheath, lying behind and between the common carotid artery and internal jugular vein. The nerves of opposite sides have, in this part of their course, similar relations, but beyond the neck their relations differ.

On the RIGHT SIDE the nerve passes over the subclavian artery, and enters the thorax by passing behind the right innominate vein; it then passes on the side of the trachea to the posterior surface of the root of the

* Communications have already been described as existing between the otic ganglion and the auriculo-temporal nerve, from which branches are distributed to the parotid gland. This probably explains the supposed connection between the glosso-pharyngeal nerve and parotid secretion, the secretory fibres being conveyed along the tympanic branch to the small superficial petrosal nerve, thence to the otic ganglion, and through the auriculo-temporal to the gland.

Eighth Pair of Nerves.

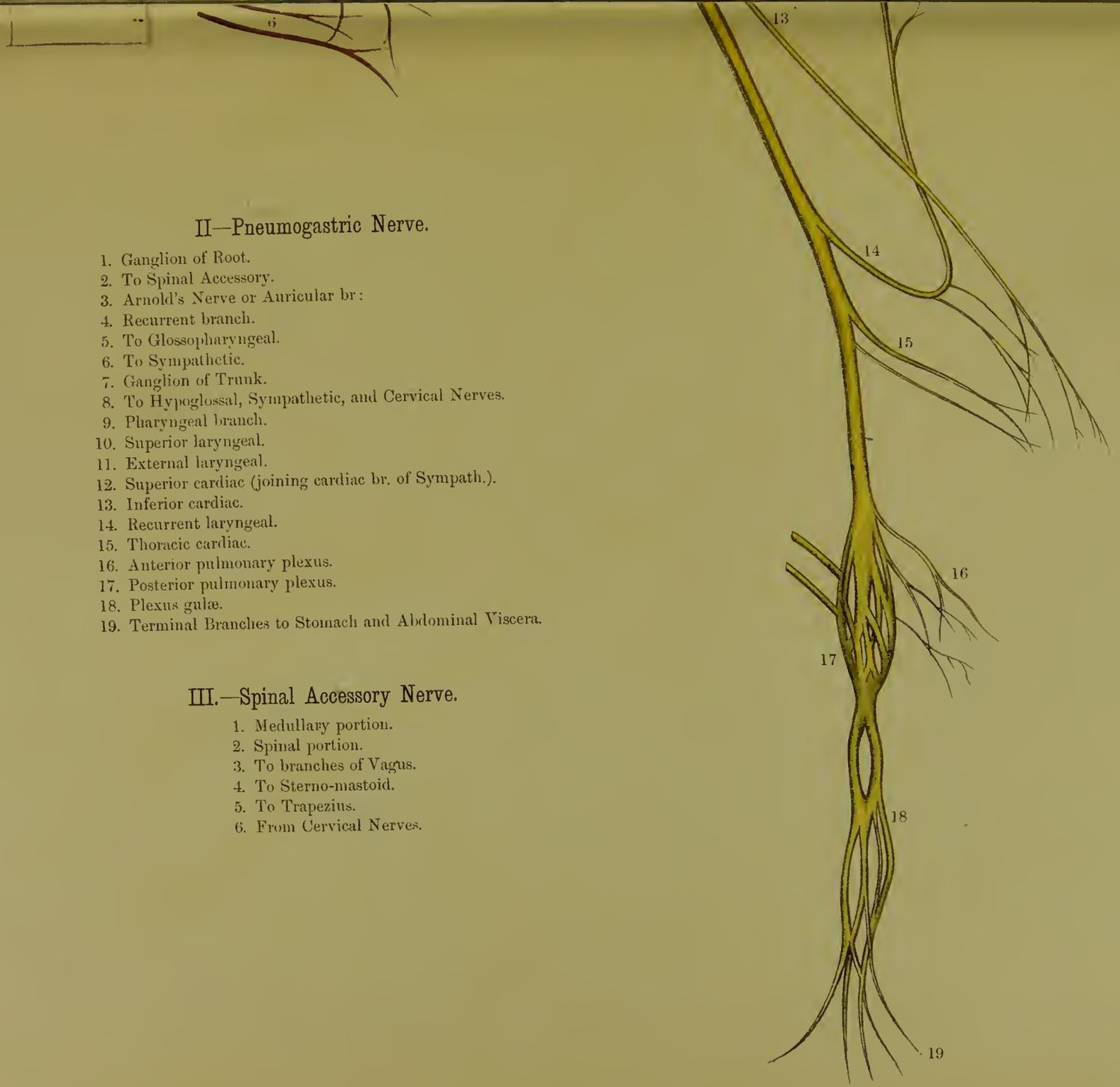


I.—Glossopharyngeal Nerve.

1. Jugular Ganglion.
2. Petrous Ganglion.
3. Tympanic branch.
4. Communication with Arnold's Nerve.
5. „ „ Pneumogastric.
6. „ „ Sympathetic.
7. To Carotid Plexus.
8. Tonsillitic.
9. Pharyngeal.
10. Lingual.

Tympanic Branch (3).

a. To Mastoid cells.
b. To Fenestra rotunda.
c. To Fenestra ovalis.
d. To Eustachian tube.
e. Small Superficial Petrosal.



II—Pneumogastric Nerve.

1. Ganglion of Root.
2. To Spinal Accessory.
3. Arnold's Nerve or Auricular br:
4. Recurrent branch.
5. To Glossopharyngeal.
6. To Sympathetic.
7. Ganglion of Trunk.
8. To Hypoglossal, Sympathetic, and Cervical Nerves.
9. Pharyngeal branch.
10. Superior laryngeal.
11. External laryngeal.
12. Superior cardiac (joining cardiac br. of Sympath.).
13. Inferior cardiac.
14. Recurrent laryngeal.
15. Thoracic cardiac.
16. Anterior pulmonary plexus.
17. Posterior pulmonary plexus.
18. Plexus gulæ.
19. Terminal Branches to Stomach and Abdominal Viscera.

III.—Spinal Accessory Nerve.

1. Medullary portion.
2. Spinal portion.
3. To branches of Vagus.
4. To Sterno-mastoid.
5. To Trapezius.
6. From Cervical Nerves.

lung, where it divides into several branches, forming the **Posterior Pulmonary Plexus.** From this plexus the nerve issues in the form of two cords, which pass on to the œsophagus, forming there, along with the nerve of the opposite side, the **Œsophageal Plexus** or Plexus Gulæ. From this plexus the fibres pass as a single trunk, which descends on the œsophagus through the œsophageal orifice of the diaphragm, to be distributed on the posterior surface of the stomach, some of its fibres passing to the cœliac, left renal, and splenic plexuses of the sympathetic.

On the Left Side the nerve enters the thorax between the left carotid and subclavian arteries and behind the innominate vein; it then crosses the arch of the aorta, and passes behind the root of the lung, forming, like its fellow, the **Posterior Pulmonary Plexus.** It then forms the **Œsophageal Plexus** on the œsophagus, from which one trunk passes through the œsophageal opening to the front of the stomach, some fibres being prolonged between the layers of the lesser omentum to the hepatic plexus.

This relation of the two nerves to the surfaces of the stomach is explained by referring to the development of the organ, when it is found that the stomach turns over on its right side, the part which was primarily directed towards the right being afterwards placed posteriorly.

Branches of Distribution—

1. The **Recurrent or Meningeal Branch**, from the ganglion of the root to the dura mater of the posterior fossa.

2. **Auricular Branch** (Arnold's nerve).—This arises from the ganglion of the root, and receives a small twig from the glosso-pharyngeal; it enters a small opening near the root of the styloid process and traverses the petrous part of the temporal bone; crossing the aqueductus Fallopii, it communicates with the facial nerve, and emerges from the bone at the auricular fissure just in front of the mastoid process, whence it passes to the posterior surface of the auricle, the skin of which it supplies. It communicates with the posterior auricular nerve.

3. **Pharyngeal Branch** springs from the upper part of the ganglion of the trunk, its fibres being mainly derived from the spinal accessory. This branch reaches the wall of the pharynx, by passing between the external and internal carotid arteries; it there divides into several branches, which join branches of the glosso-pharyngeal and sympathetic, forming the **Pharyngeal Plexus.** This plexus distributes branches to the mucous membrane and muscles of the pharynx, and one branch joins the hypo-glosssal nerve (lingual branch of Luschka).

4. **Superior Laryngeal Nerve.**—This nerve arises from the ganglion of the trunk about its middle, and passes downwards beneath the internal carotid artery. It gives off a small external branch—the External Laryngeal, which supplies the crico-thyroid muscle, and usually communicates with the sympathetic or a cardiac branch. The remainder of the nerve passes, as the Internal Laryngeal, through the crico-thyroid membrane to supply the mucous membrane of the larynx, one branch being prolonged to the base of the tongue;—in the larynx, it communicates with the recurrent laryngeal nerve. The motor fibres of the superior laryngeal are derived from the spinal accessory nerve.

5. **Recurrent or Inferior Laryngeal Nerve.**—*On the right side*, this nerve arises at the root of the neck and winds backwards beneath the subclavian artery; the *nerve of the left side* arises in the thorax, and winds backwards round the aorta, immediately external to the ductus arteriosus. Each nerve passes obliquely upwards and inwards behind the common carotid artery, then lies in the groove between the trachea and œsophagus as far as the cricoid cartilage, where the nerve passes beneath the inferior constrictor muscle to

enter the larynx. It supplies all the intrinsic muscles of the larynx excepting the crico-thyroid, and communicates with the superior laryngeal. The nerve also gives branches to the trachea, œsophagus, inferior constrictor, and cardiac plexus.

This *recurrent course* of the inferior laryngeal nerve is explained by reference to the process of development. It is due to the branchial arches, from which the arch of the aorta and subclavian artery are developed, having originally occupied a higher position than the larynx, but, by the elongation of the neck, and the descent of the heart to the thorax, loops of the nerves have been drawn down by the arches over which they previously simply passed vertically downwards.

6. **Cardiac Branches.**—(Two sets—cervical and thoracic).

(*a*) Cervical Cardiac.—The *upper ones* are of small size, and join the cardiac branches of the sympathetic. The *lower branch*, which arises at the root of the neck, differs on the two sides. The lower branch on the *right side* passes to the deep cardiac plexus; while that on the *left side* crosses the arch of the aorta, to enter the superficial cardiac plexus.

(*b*) Thoracic Cardiac. — On the right side these are partly derived, while on the left side they are entirely derived, from the recurrent laryngeal branch. On both sides they enter the deep cardiac plexus.

7. **Pulmonary Branches.**—A few twigs reach the front of the root of the lung, which join with branches of the sympathetic to form the Anterior Pulmonary Plexus. The Posterior Pulmonary Plexus is formed by the splitting up of the fibres of the trunk, joined by fibres from the second, third, and fourth thoracic ganglia of the sympathetic. From the plexuses, branches pass to the lungs.

8. **Œsophageal Branches.**—Branches are given off above and below the root of the lung, the lower ones form the plexus gulæ.

9. **Gastric Branches.**—These have been previously traced.

SPINAL ACCESSORY NERVE.—(Plate V.)

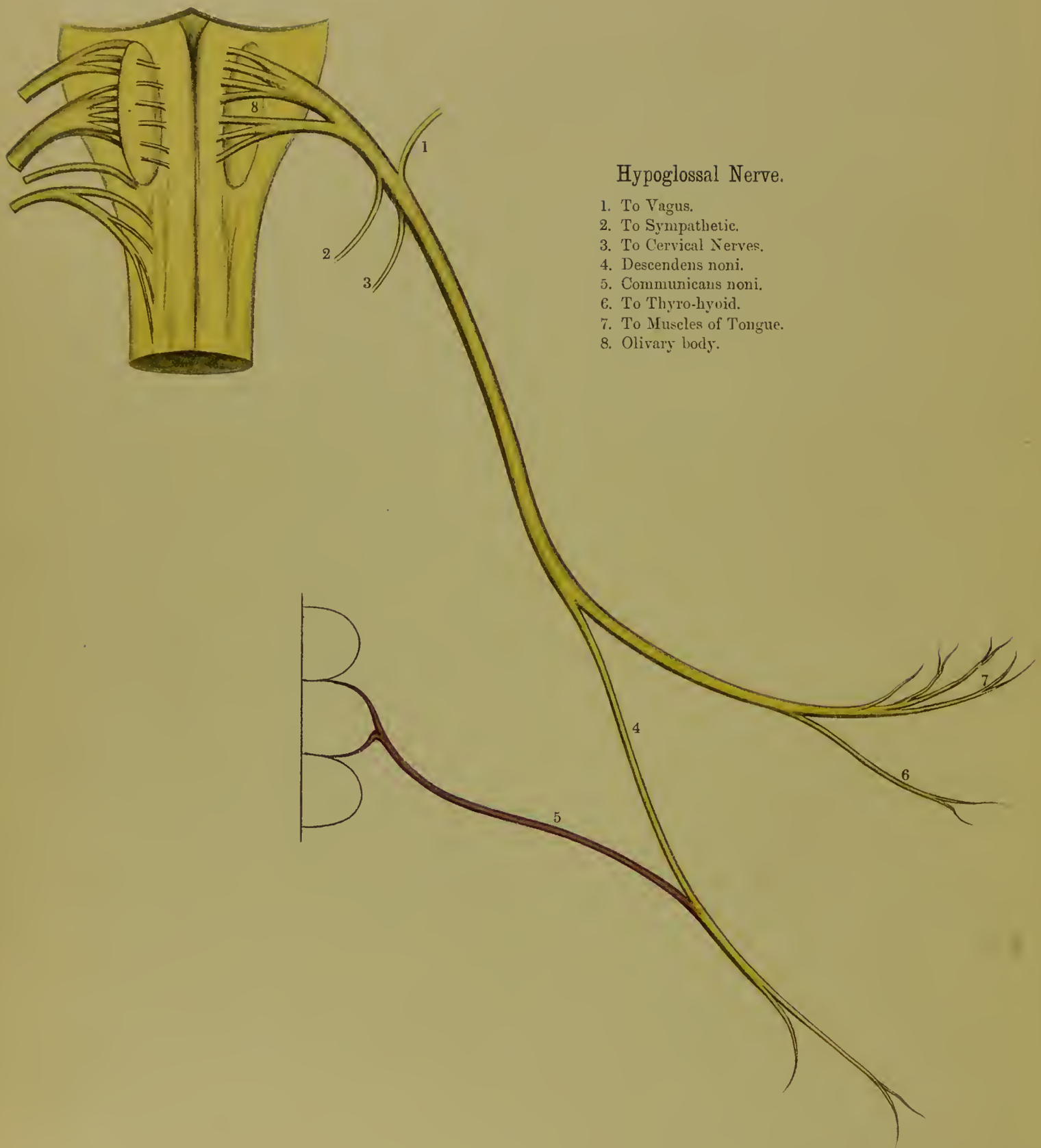
This nerve consists of two parts—a spinal part from the spinal cord, and an accessory part from the medulla.

The **Accessory portion** arises from the medulla, just below the vagus, and also from the grey matter behind the upper part of the central canal. The nerve leaves the skull through the jugular foramen and passes over the surface of the ganglion of the trunk of the vagus to join that nerve beyond the ganglion, some of the fibres passing into the pharyngeal and superior laryngeal branches.

The **Spinal portion** arises from the spinal cord, as low as the sixth cervical nerve, being attached below to the intermedio-lateral tract and base of the anterior horn, while above, its attachment approaches the posterior horn. The nerve passes upwards between the ligamentum denticulatum and the posterior roots to enter the skull through the foramen magnum, and immediately bends outwards to pass through the jugular foramen along with the vagus.

In the neck it passes over the internal jugular vein. It then pierces and supplies the sterno-mastoid, crosses the posterior triangle of the neck to enter the under surface of the trapezius, which it supplies, and communicates with the third and fourth cervical nerves. It communicates also with branches of the cervical plexus amongst the fibres of the sterno-mastoid and in the posterior triangle.

Hypoglossal Nerve.



Hypoglossal Nerve.

1. To Vagus.
2. To Sympathetic.
3. To Cervical Nerves.
4. Descendens noni.
5. Communicans noni.
6. To Thyro-hyoid.
7. To Muscles of Tongue.
8. Olivary body.

A. W. HUGHES

T. MURRAY

HYPO-GLOSSAL NERVE.—(Plate VI.)

Deep Origin—

From a column of grey matter which lies close to the middle line of the floor of the fourth ventricle, beneath the fasciculus teres; also from the antero-lateral part of the grey matter around the upper part of the central canal.

Superficial Origin.—By ten to fifteen filaments from the groove between the anterior pyramid and olivary body. The filaments are collected into two bundles which pierce the dura mater separately, and pass through the anterior condyloid foramen, where they form one trunk. In the neck the nerve is directed downwards between the internal carotid artery and internal jugular vein to the lower border of the digastric muscle, where it bends forwards over the external carotid artery, hooking round the commencement of the occipital artery. Thence it passes forwards above the hyoid bone, to the under surface of the tongue, by passing beneath the mylo-hyoid, and lying upon the hyo-glossus muscle. At the anterior border of this latter muscle, it communicates with the lingual nerve, and gives off branches to the extrinsic and intrinsic muscles of the tongue.

Just beneath the skull the nerve is connected with the sympathetic, with the first and second cervical nerves, and with the ganglion of the trunk of the vagus.

Branches of Distribution—

1. **Descendens noni.**—This is given off just as the nerve crosses the occipital artery; it passes downwards in front of the carotid artery, lying superficial to or within the carotid sheath; and, having been joined by branches from the second and third cervical nerves *(communicantes noni)*, it supplies the sterno-hyoid, sterno-thyroid, and omo-hyoid muscles.

2. **Branch to Thyro-hyoid**—given off before the nerve reaches the hyoid bone.

3. **Branches to Muscles of the Tongue**—to stylo-glossus, hyo-glossus, genio-hyoid, genio-hyo-glossus, and all the intrinsic muscles.

SPINAL NERVES.

The spinal nerves arise from the spinal cord, and consist of thirty-one pairs, which are named according to the vertebræ in relation to which they emerge; and in general the number of pairs corresponds to the number of vertebræ in the several regions, excepting the cervical and coccygeal nerves—there being eight pairs of cervical nerves, while there is but one pair of coccygeal nerves. Each spinal nerve arises by two roots, an anterior or motor, and posterior or sensory—the posterior root having a ganglion upon it, which, in most regions, lies in the inter-vertebral foramen through which the nerve emerges. The spinal nerve roots vary in size, being very large in the lower cervical, lower lumbar, and upper sacral regions, corresponding to the various plexuses from which nerves are given off to the upper and lower limbs.

The nerve roots also vary in length and direction. Those of the cervical nerves being short and transverse, while the lumbar, sacral, and coccygeal nerve roots are of great length and vertical in direction.

These differences in the length and direction of the nerve roots is due to the termination of the spinal cord at the first lumbar vertebra, the various nerve roots given off from the lower region of the cord having thus to descend vertically, in the spinal canal, ere they reach their respective foramina of exit.

Immediately beyond the ganglion the two roots join to form a short trunk or spinal nerve proper, which divides into anterior and posterior primary divisions. These divisions differ from the nerve roots in containing motor and sensory fibres, due to an intimate admixture of fibres which occurs in the short trunk which constitutes the spinal nerve. (See diagram of Intercostal Nerve in Plate VIII.)

The posterior divisions are destined for the supply of the muscles and skin of the back, the anterior divisions enter into the formation of the various nerve plexuses, and supply the muscles and integuments of the upper and lower extremities, and of the antero-lateral regions of the neck, thorax, and abdomen.

POSTERIOR PRIMARY DIVISIONS OF SPINAL NERVES.

The posterior primary divisions turn backwards and, with four exceptions, divide into internal and external branches, which supply the integument and muscles of the back. The nerves, the posterior divisions of which do not divide into internal and external branches, are the first cervical, the two lowest sacral, and coccygeal nerves.

The Posterior Division of the First Cervical or Sub-occipital Nerve emerges between the vertebral artery and posterior arch of the atlas, enters the sub-occipital triangle and supplies the muscles in relation to that space—viz., the two oblique muscles, the recti postici (major and minor), and the complexus.

The Posterior Divisions of the Two Lowest Sacral and the Coccygeal Nerves are connected together by loops, and terminate in the integument in the region of the coccyx.

The **Internal** and **External** branches of those nerves which divide, supply the muscles of the back in all the regions, but they vary in their cutaneous distribution. In the upper dorsal and cervical regions, cutaneous branches are given off from the internal branches, excepting the three lowest cervical, whose internal branches usually terminate in the muscles and do not reach the skin. In the lower dorsal, lumbar, and sacral regions, cutaneous filaments are given off from the external branches, while the internal branches terminate in the muscles.

N. B.—It may be broadly stated that above the sixth dorsal nerve cutaneous filaments are given off from the internal branches, while the external branches terminate in the muscles; but below the sixth dorsal nerve, cutaneous filaments are derived from the external branches, as the internal branches terminate in the muscles.

Of the internal branches, that of the second cervical nerve requires special mention. This branch, which is known as the **Great Occipital Nerve,** is of large size, reaches the surface in the occipital region about an inch below, and external to, the occipital protuberance, and is distributed to the skin of the back of the head, and communicates with the small occipital nerve. In its course to the surface it pierces the complexus and trapezius muscles.

ANTERIOR PRIMARY DIVISIONS OF SPINAL NERVES.

The anterior primary divisions, as previously mentioned, are distributed to the upper and lower extremities and to the muscles and integument of the neck, thorax, and abdomen.

Each anterior division is connected, close to its origin, by one or two filaments, with a ganglion of the sympathetic, and with the exception of those in the dorsal region, all the anterior divisions form the various plexuses.

CERVICAL NERVES.—(Plate VII.)

The anterior divisions of the upper four form the cervical plexus. The anterior divisions of the lower four, with part of the first dorsal nerve, form the brachial plexus.

CERVICAL PLEXUS.

The cervical plexus lies beneath the sterno-mastoid, and between the rectus capitis anticus major and scalenus medius muscles. The nerves which enter into its formation have the following arrangement:—

The first cervical or sub-occipital nerve, after crossing the transverse process of the atlas, and having supplied the recti laterales and antici muscles, joins the second cervical nerve. The second, third, and fourth nerves divide into ascending and descending branches. These join to form a series of loops, which constitute the plexus.

Branches.—The branches consist of two sets—Superficial, to the integument; and Deep branches, which pass mostly to muscles.

SUPERFICIAL BRANCHES (Ascending and Descending).—(Plate III.)

These lie immediately beneath the platysma.

1. Ascending Branches—from the second and third nerves.

(*a*) **Superficial Cervical Nerve.**—This nerve crosses the sterno-mastoid from behind forwards, and divides into two branches, upper and lower, which supply the skin of the side of the neck. The upper branch communicates with the infra-maxillary brauch of the facial nerve; the lower branch extends as far as the sternum.

(*b*) **Great Auricular Nerve.**—This runs upwards obliquely on the surface of the sterno-mastoid, towards the ear, a little below which it divides into—

Facial Branches, to the skin over the parotid gland.

Auricular Branches, which supply the skin of the ear, and communicate with the posterior auricular nerve.

Mastoid Branches, which supply the skin over the mastoid process, and communicate with the small occipital nerve.

(*c*) **Small Occipital Nerve.**—This nerve runs upwards to the head, along the posterior border of the sterno-mastoid muscle, and supplies the skin between the great auricular and great occipital nerves, with both of which nerves it communicates.

2. Descending Branches.—These branches are derived from the third and fourth cervical nerves, and pass down the side of the neck, and terminate by passing over the clavicle. The Inner Branch (sternal) passes over the inner third of the bone; the Middle Branch (clavicular) crosses the bone about its middle, and terminates in the skin of the chest; the Outer Branch (acromial) passes to the skin of the shoulder.

DEEP BRANCHES.

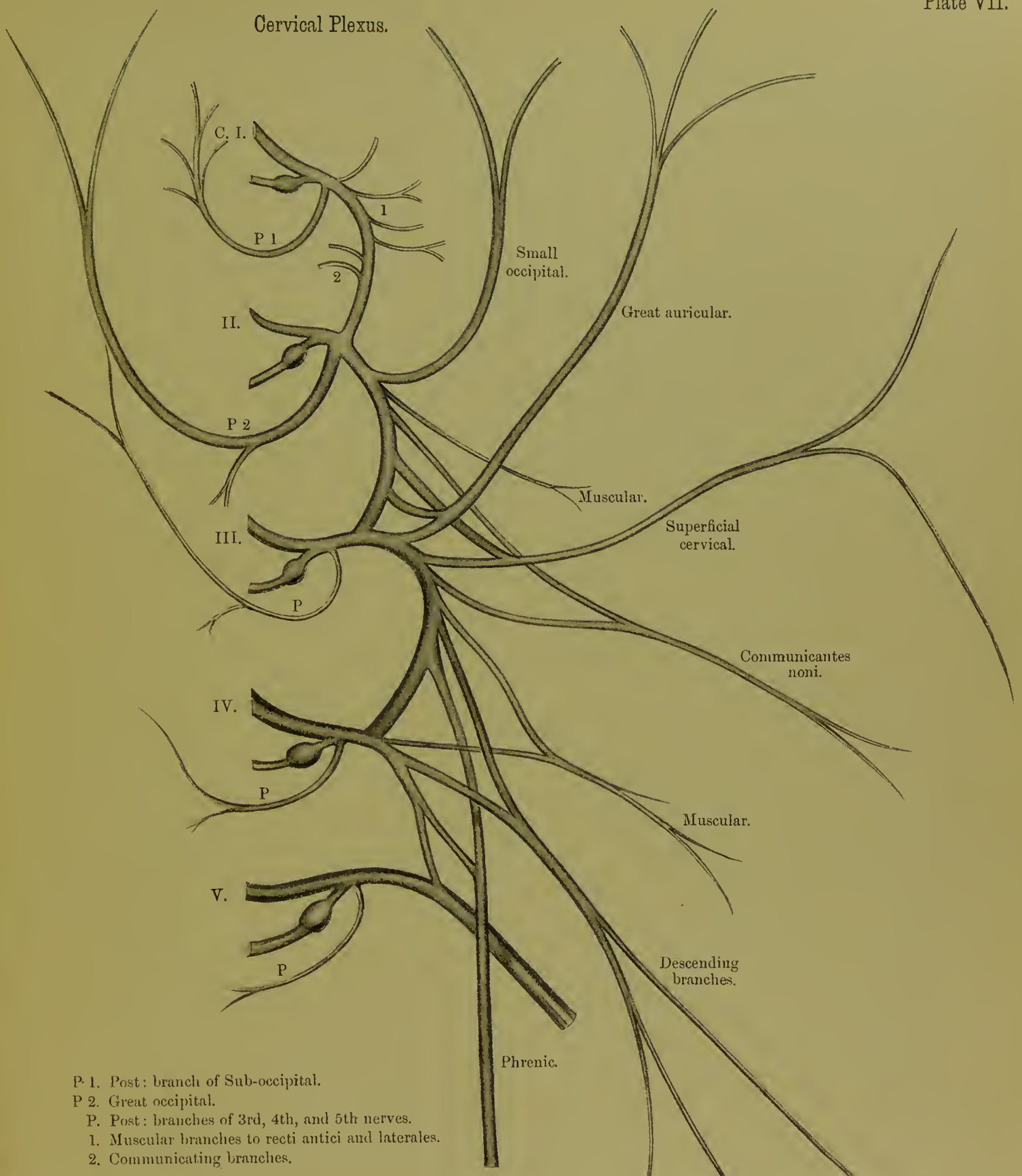
These consist of an external and an internal set.

1. External Branches—

(*a*) **Muscular Branches.**—Branches are derived from the second nerve to the sterno-mastoid, and from the third and fourth nerves to the scalenus medius, levator anguli scapulæ, and trapezius muscles.

(*b*) **Branches of Communication.**—The cervical nerves communicate with the spinal accessory in the sterno-mastoid, in the posterior triangle, and beneath the trapezius.

Cervical Plexus.



P 1. Post: branch of Sub-occipital.
P 2. Great occipital.
P. Post: branches of 3rd, 4th, and 5th nerves.
1. Muscular branches to recti antici and laterales.
2. Communicating branches.

A W HUGHES

J T MURRAY DEL

2. Internal Branches—

(*a*) **Connecting Branches,** with hypo-glossal, pneumogastric, and sympathetic nerves.

(*b*) **Muscular Branches** to the prevertebral muscles.

(*c*) **Communicantes Noni,** which pass inwards over or beneath the internal jugular vein to join the descendens noni.

(*d*) **Phrenic Nerve.**—This nerve is mainly derived from the fourth cervical nerve, but usually receives filaments from the third and fifth nerves. It passes down the neck, lying on the surface of the scalenus anticus muscle, and enters the thorax by passing between the subclavian vein and artery, and crosses the internal mammary artery obliquely from without inwards, near its origin; it then passes in front of the root of the lung, where it lies between the pleura and pericardium. Finally, it divides into four or five branches, which pierce the diaphragm separately, to supply that muscle on its under surface.

The left phrenic is the longer of the two, due to the projection, towards the left side, of the pericardium, round which it winds, and also due to the diaphragm being on a lower level on the left side. The left nerve also crosses the arch of the aorta.

The phrenic nerve is sometimes connected with the nerve to the subclavius muscle, with the descendens noni and sympathetic, and is described as giving branches to pleura, pericardium, and peritoneum.

BRACHIAL PLEXUS.—(Plate VIII.)

The brachial plexus lies at the root of the neck and upper part of the axilla, and is formed by the anterior divisions of the lowest four cervical nerves, and a considerable portion of the first dorsal nerve, and usually receives a small twig from the fourth cervical nerve. The nerves appear between the scalenus anticus and scalenus medius muscles, and have the following arrangement:—

The fifth and sixth cervical nerves join to form an upper trunk, the seventh, remaining separate, forms a middle trunk, and a lower trunk is formed by the union of the eighth cervical and first dorsal nerves.

Each of the three trunks thus formed divides into an anterior and posterior branch, and the anterior branch of the trunk formed by the fifth and sixth nerves joins the anterior branch of the seventh nerve to form the outer cord of the plexus.

The anterior branch of the trunk formed by the eighth cervical and first dorsal nerves passes down as the inner cord of the plexus.

The three posterior branches join to form the posterior cord of the plexus.

The brachial plexus varies greatly in its formation, but the above is the most common arrangement.

The three cords are external to the first part of the axillary artery; but lower down, the inner cord becomes internal, and the posterior cord becomes posterior to the vessel, in its second part—the outer cord remaining external to it.

BRANCHES.—The branches consist of two sets—viz., those given off at the root of the neck, or above the clavicle, and those given off in the axilla, or below the clavicle.

Branches above the Clavicle—

1. **Muscular Branches** to the longus colli and scaleni.
2. **Nerve to Rhomboid Muscles,** given off from the fifth nerve; this also supplies the levator anguli scapulæ.
3. **Nerve to the Subclavius,** from the trunk formed by the fifth and sixth nerves. This nerve crosses the third part of the subclavian artery.
4. **Branch to join the Phrenic,** from the fifth nerve.
5. **Posterior Thoracic** (nerve of Bell), from the fifth and sixth nerves, which supplies the serratus magnus.
6. **Supra-scapular Nerve,** from the trunk formed by the fifth and sixth nerves. This nerve passes beneath the trapezius and reaches the dorsum of the scapula through the supra-scapular notch. It supplies the supra-spinatus and infra-spinatus, and an articular twig to the shoulder joint.

Branches below the Clavicle—

From the Outer Cord.—External anterior thoracic, musculo-cutaneous, and outer head of median nerve.

From the Inner Cord.—Internal anterior thoracic, lesser internal cutaneous, internal cutaneous, ulnar, inner head of median.

From the Posterior Cord.—Three subscapular nerves, circumflex, and musculo-spiral.

Branches of Outer Cord—

External Anterior Thoracic.—This nerve supplies the pectoralis major, and joins the internal anterior thoracic nerve.

Musculo-Cutaneous.—This nerve pierces the coraco-brachialis, and then passes obliquely between the biceps and brachialis anticus, to appear at the elbow on the outer side of the tendon of the biceps, where it passes beneath the median cephalic vein and divides into anterior and posterior branches. In its course through the arm it supplies the coraco-brachialis, biceps, and brachialis anticus, and a small branch to the humerus which accompanies the nutrient artery. Its terminal branches supply the skin of the front and back of the forearm near its radial border, extending as far as the wrist and root of the thumb.

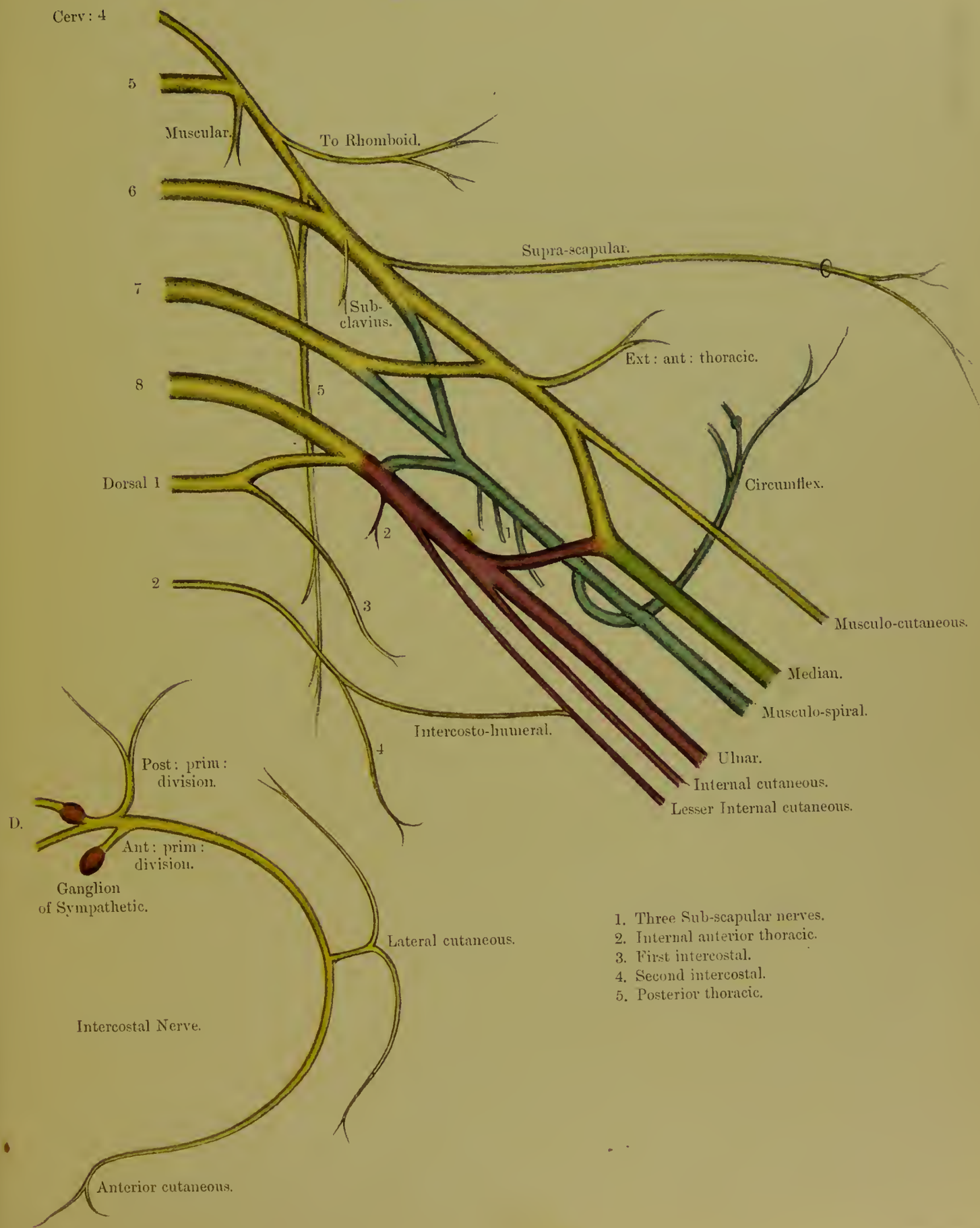
Branches of Inner Cord—

Internal Anterior Thoracic communicates with the external anterior thoracic branch, and supplies the great and small pectoral muscles.

Lesser Internal Cutaneous (nerve of Wrisberg). supplies the skin of the lower half of the upper arm on its inner and posterior aspects, and is joined by the intercosto-humeral nerve.

Internal Cutaneous Nerve passes downwards on the inner side of the brachial artery, becomes cutaneous in the lower third of the arm, and divides into two branches (anterior and posterior), which supply the skin of the anterior and posterior aspects of the forearm near the ulnar border.

Brachial Plexus.



1. Three Sub-scapular nerves.
2. Internal anterior thoracic.
3. First intercostal.
4. Second intercostal.
5. Posterior thoracic.

A W HUGHES

Ulnar Nerve.—The ulnar nerve lies along the inner side of the brachial artery in the upper half of the arm, it then pierces the internal inter-muscular septum along with the inferior profunda artery, and reaches the interval between the internal condyle and olecranon, and enters the forearm. Here it continues a straight course as far as the wrist, lying beneath the flexor carpi ulnaris and close to the inner side of the ulnar artery in its lower two thirds. It enters the hand by passing over the anterior annular ligament along with the ulnar artery, lying between that artery and the pisiform bone. In the palm, it divides into a *Superficial Portion*, which supplies **Digital Branches** to the little and ulnar border of the ring fingers, and a *Deep Branch*, which accompanies the deep branch of the ulnar artery and supplies the short muscles of the little finger—the two inner lumbrical muscles—the interossei, the adductor and inner half of the flexor brevis pollicis muscles. In its course the ulnar nerve gives off the following branches:—

1. **Articular Branch**, to the elbow-joint.
2. **Muscular Branches**, to the flexor carpi ulnaris and inner half of the flexor profundus digitorum.
3. **Dorsal Branch**, which reaches the back of the hand by passing beneath the tendon of the flexor carpi ulnaris about two or three inches above the wrist, and supplies the skin of the inner side of the little finger, and adjacent sides of the little and ring fingers on their dorsal surfaces.
4. **Palmar Branch**, given off about two inches above the wrist, accompanies the ulnar artery and supplies the skin of the palm.
5. **Terminal Branches** (described above).

From Outer and Inner Cords—

MEDIAN NERVE.

The **Median Nerve** arises from the outer and inner cords by two roots which embrace the lower part of the axillary artery. The nerve passes down the arm in company with the brachial artery, lying first external to that vessel; it then crosses inwards over (sometimes under) the artery, and lies internal to it at the elbow. The nerve then enters the forearm between the two heads of the pronator radii teres, and crosses the ulnar artery near its origin, and in the forearm lies between the flexor sublimis and flexor profundus digitorum muscles. It enters the hand by passing beneath the anterior annular ligament, and in the palm becomes expanded and gives off its terminal branches.

Branches—

In the Forearm—

1. **Articular Branches**, to the elbow-joint.
2. **Museular Branches**, to the flexor carpi radialis, pronator radii teres, palmaris longus, and to the flexor sublimis digitorum.
3. **Anterior Interosseous.**—This nerve accompanies the artery of the same name, and supplies the outer half of the flexor digitorum and pronator quadratus, beneath which muscle it terminates by supplying a small twig to the wrist-joint.
4. **Palmar Cutaneous.**—This branch pierces the deep fascia at the lower part of the forearm, and passes over the anterior annular ligament to supply the skin of the palm.

In the Hand—

The expansion above mentioned divides into two parts, the outer of which gives off muscular branches to the short muscles of the thumb—viz., abductor opponens and outer head of flexor brevis pollicis, and three **Digital Branches,** to the thumb (both sides) and outer side of the index finger, and from this last branch a twig is given to the outer lumbrical muscle.

The inner portion of the expansion divides into two **Digital Branches,** which divide to supply the middle finger and adjacent sides of the index and ring fingers.

From the outer branch a twig is given to the second lumbrical muscle.

From the Posterior Cord—

THREE SUBSCAPULAR NERVES.

The **Upper** supplies the subscapularis.

The **Lower** supplies the teres major and the lower part of the subscapularis.

The **Long Subscapular Nerve** supplies the latissimus dorsi.

THE CIRCUMFLEX NERVE.

This nerve lies behind the lower part of the axillary artery and passes with the posterior circumflex artery through the quadrilateral space external to the long head of the triceps; it then winds round the surgical neck of the humerus, and divides into branches which are mainly distributed to the deltoid muscle.

Besides the branches to the deltoid, filaments are also given to the skin over that muscle, to the shoulder joint, and to the teres minor muscle, this last branch having a gangliform enlargement upon it.

MUSCULO-SPIRAL NERVE.

This is the largest branch of the brachial plexus, and lies at first beneath the lower part of the axillary and upper part of the brachial arteries, it then passes between the outer and inner heads of the triceps and enters the musculo-spiral groove, through which it winds to the outer side of the limb, and reaches the interval between the supinator longus and brachialis anticus by piercing the external inter-muscular septum. Between these muscles it descends to the level of the external condyle, where it terminates by dividing into the radial and posterior interosseous nerves.

Branches.—Besides its terminal branches above mentioned, three sets are given off from the nerve—some being given off before it enters the musculo-spiral groove, others as it lies in the groove, and some after the nerve leaves the groove.

Before the Nerve enters the Groove it distributes **Muscular Branches** to the inner and long heads of the triceps and the **Internal Cutaneous Branch,** which supplies the skin of the arm behind the intercosto-humeral nerve.

As the Nerve lies in the Groove, branches are given to the inner and outer heads of the triceps and a branch to the anconeus, which is of great length and descends in the substance of the inner head of the triceps or between that muscle and the bone.

After the Nerve leaves the Groove, the **External Cutaneous Branches** arise—the *upper* of which supplies the skin of the outer side of the upper arm on its anterior aspect; the *lower* branch supplies the skin of the outer side of the forearm and lower part of the arm. **Muscular Branches** are supplied to the supinator longus, extensor carpi radialis longior, and brachialis anticus.

RADIAL NERVE.

The radial, which is entirely a cutaneous nerve, is continued downwards beneath the supinator longus and lies in close contact with the radial artery on its outer side about its middle; but in the lower part of the forearm it passes backwards beneath the tendon of the supinator longus, and supplies digital branches to the thumb, index, middle, and radial half of the ring fingers on their dorsal surfaces.

POSTERIOR INTEROSSEOUS NERVE.

This nerve winds round the upper end of the radius, and pierces the supinator brevis to reach the back of the limb: there it lies for some distance between the superficial and deep layers of muscles; but a little below the middle of the forearm it dips beneath the extensor secundi internodii pollicis to reach the interrosseous membrane, on which it is continued as far as the back of the wrist, where it terminates beneath the extensor tendons in a gangliform enlargement, from which filaments are distributed to the articulations of the carpus. In its course muscular branches are supplied to the extensor carpi radialis brevior, supinator brevis, extensor communis digitorum, extensor minimi digiti, extensor carpi ulnaris, the three extensors of the thumb, and the extensor indicis.

DORSAL NERVES.—(Plate VIII.)

The anterior divisions of the twelve dorsal nerves pass forwards below the corresponding ribs, to terminate near the middle line in front, and they all lie in the intercostal spaces forming the intercostal nerves, excepting the last, which runs forward below the last rib, and therefore lies in the abdominal wall. The larger part of the first dorsal joins the brachial plexus.

COURSE OF THE UPPER INTERCOSTAL NERVES.

These nerves accompany the intercostal vessels, and lie first between the external intercostal and the membranous backward prolongation from the internal intercostal muscle. They afterwards lie between the two intercostal muscles as far as a point about midway between the spine and sternum, where the lateral cutaneous branch is given off. The nerve, thus diminished in size, passes forwards in the fibres of the internal intercostal muscle, and between the costal cartilages, reaches the inner surface of the internal intercostal, and lies between that muscle and the pleura. Near the sternum the nerve terminates by piercing the internal intercostal muscle to reach the surface, forming the anterior cutaneous nerves, which bend outwards and supply the skin over the pectoralis major.

LATERAL CUTANEOUS NERVES.

With the exception of those given off from the second and twelfth dorsal nerves, the lateral cutaneous branches pierce the external intercostal muscle and divide into *Anterior* and *Posterior Branches;* the anterior branches pass forwards over the pectoralis major, while the posterior set turn backwards over the latissimus dorsi.

The First Dorsal Nerve usually gives off no lateral branch.

The Lateral Branch of the Second Nerve or Intercosto-Humeral does not divide into two branches, but passes backwards across the floor of the axilla, and, after communicating with the nerve of Wrisberg, it supplies the skin of the inner and posterior surfaces of the arm.

COURSE OF THE LOWER INTERCOSTAL NERVES.

Beyond the sixth, where the intercostal spaces are deficient in front, the nerves are prolonged forwards between the internal oblique and transversalis muscles, and reach the surface near the middle line by piercing the rectus abdominis and its sheath.

The Last Dorsal Nerve, after crossing the quadratus lumborum, pierces the posterior aponeurosis of the transversalis muscle, and passes forwards between that muscle and the internal oblique, following a course similar to that of the lower intercostal nerves in the abdominal wall. Its *Lateral Cutaneous Branch* passes over the iliac crest to the skin of the gluteal region.

LUMBAR NERVES.

The upper three and part of the fourth lumbar nerves form the lumbar plexus. A small part of the fourth joins the fifth nerve to form the lumbo-sacral cord.

LUMBAR PLEXUS.—(Plate IX.)

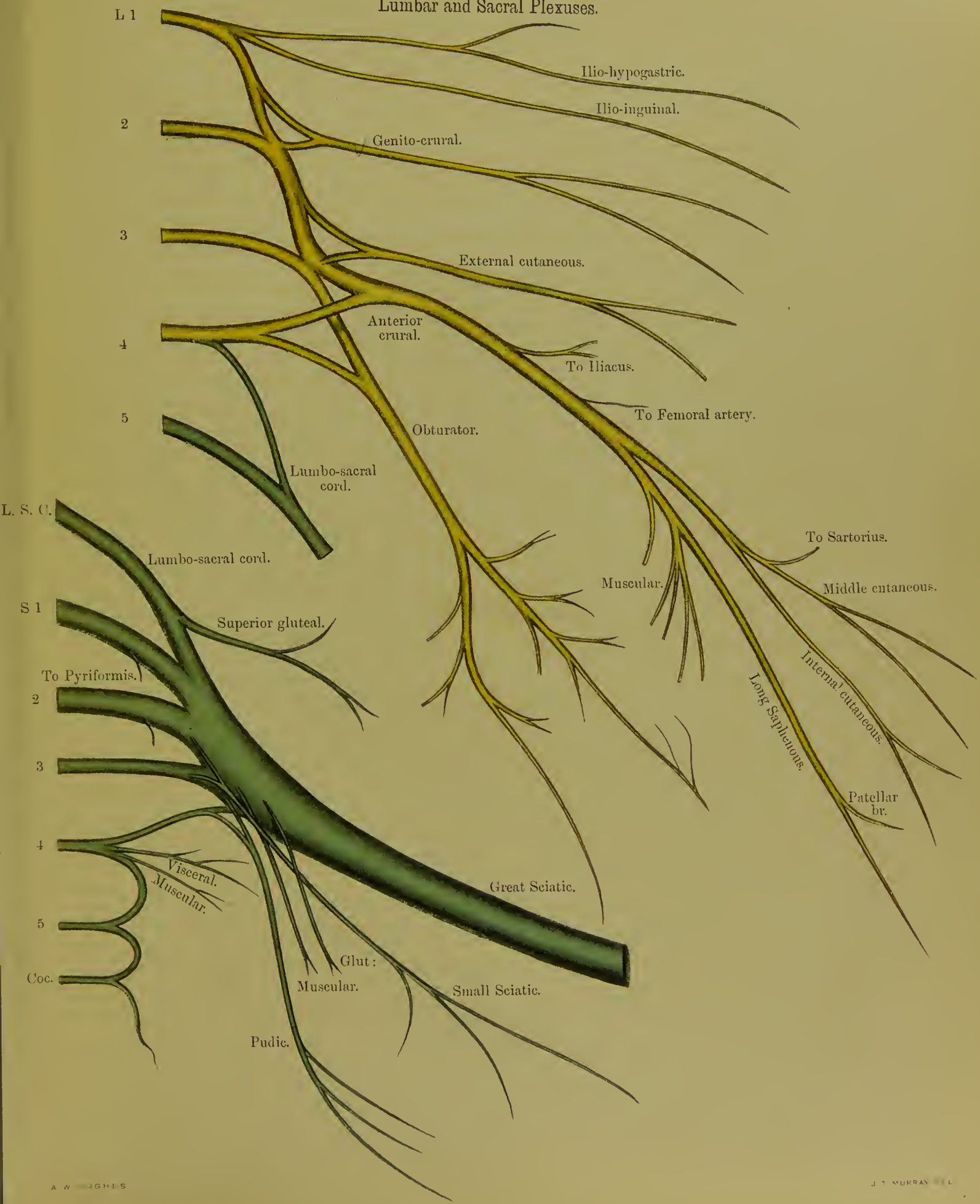
This plexus lies in the substance of the psoas muscle, in front of the transverse processes of the vertebræ, and is formed by the junction of the four upper lumbar nerves in loops; and from the plexus thus formed several nerves are supplied to the lower part of the abdomen and to the front and inner side of the lower extremity.

BRANCHES.—The ilio-hypogastric and ilio-inguinal nerves are derived from the first nerve; from the first and second, the genito-crural arises; the external cutaneous, from the second and third nerves; from the second, third, and fourth, the fibres of the anterior crural are derived; and the obturator arises from the third and fourth nerves.

The Ilio-Hypogastric Nerve arises from the first nerve, appears at the upper part of the outer border of the psoas, crosses the quadratus lumborum, and then lies between the internal oblique and transversalis muscles; it pierces the internal and external oblique, and appears through the tendon of the latter muscle a little above and external to the external abdominal ring, and supplies the skin over the hypogastric region.

An Iliac Branch is supplied to the skin of the buttock, which crosses the crest of the ilium a little behind the iliac branch of the last dorsal nerve.

Lumbar and Sacral Plexuses.



The **Ilio-Inguinal Nerve** arises from the first nerve, and has a course similar to the ilio-hypogastric nerve, but lies on a slightly lower level. It becomes superficial in front by passing through the external abdominal ring, and supplies the integuments of the inguinal region and scrotum or labia pudendi. It does not furnish an iliac branch.

The **Genito-Crural Nerve** is derived from the first and second nerves, and having pierced the psoas it descends on the surface of that muscle, and divides into a Genital Branch, which passes over the external iliac artery to the inguinal canal and supplies the cremaster muscle, and a Crural Branch, which passes beneath Poupart's ligament on the outer side of the external iliac artery and supplies the skin over Scarpa's triangle.

The **External Cutaneous Nerve** arises from the second and third nerves, and appears at the outer border of the psoas muscle. It crosses the iliac fossa obliquely, and passes beneath Poupart's ligament close to the anterior superior spine, and divides into anterior and posterior branches.

The Anterior Branch supplies the skin of the outer part of the anterior surface of the thigh as far as the knee.

The Posterior Branch supplies branches to the skin of the outer side of the buttock and upper part of the thigh.

The **Anterior Crural Nerve** is derived from the second, third, and fourth nerves, and emerges along the outer side of the psoas at its lower part. It passes beneath Poupart's ligament, between the psoas and iliacus muscles, and lies about half an inch external to the femoral artery. At the upper part of Scarpa's space it divides into superficial and deep divisions. The trunk of the nerve supplies branches to the iliacus muscle and to the femoral artery.

The Anterior Division gives off the middle and internal cutaneous nerves, and a branch to the pectineus, which passes behind the femoral artery.

The **Middle Cutaneous** pierces and supplies the sartorius muscle, and divides into two branches, which supply the skin of the front of the thigh as far as the knee.

The **Internal Cutaneous** passes down over the femoral artery, and divides into an Anterior Branch, which supplies the skin as far as the knee, and a Posterior Branch, which descends on the inner side of the knee to supply the skin of the upper part of the leg on its inner side.

Deep or Posterior Division.—This supplies branches to the muscles of the front of the thigh, and gives off one cutaneous nerve—viz., the long saphenous.

Muscular Branches.—These supply the rectus femoris, vastus externus, crureus, and vastus internus, and from some of these branches twigs pass to the hip joint; while from the nerves, to the two vasti and crureus, branches are prolonged down to the knee joint.

Internal or Long Saphenous Nerve.—This is the largest branch of the anterior crural, and descends in close contact with the femoral artery, through Hunter's canal, lying first on the outer side, then crossing over to the inner side of the vessel. It becomes superficial on the inner side of the knee, by appearing from under the sartorius, and is continued along the inner side of the leg with the saphenous vein, and terminates about the middle of the inner border of the foot, after passing in front of the internal malleolus. In addition to branches which supply the skin of the inner surface of the leg and foot, it gives off a Communicating Branch to join branches of the obturator and internal cutaneous beneath the sartorius, and a Patellar Branch, which pierces the sartorius and joins branches of the internal, middle, and external cutaneous nerves on the front of the knee, forming the Patellar Plexus.

Obturator Nerve. — This nerve arises from the third and fourth nerves (sometimes from the second), and emerges on the inner side of the psoas. It runs along the outer wall of the pelvis, above the obturator vessels, to the upper part of the obturator foramen. In the foramen it divides into superficial and deep divisions.

The **Superficial or Anterior Division** enters the thigh above the obturator externus muscle and passes down over the adductor brevis, but behind the adductor longus, and furnishes the following branches:—

1. Muscular Branches to the gracilis, adductor longus, and usually to the adductor brevis and pectineus.
2. Articular Branch, to the hip joint.
3. Communicating Branch, to join branches of the internal saphenous and internal cutaneous nerves beneath the sartorius.
4. Branch to the Femoral Artery.

The **Posterior or Deep Division** pierces the obturator externus and passes behind the adductor brevis to the anterior surface of the adductor magnus, the two divisions of the obturator being thus separated by the adductor brevis and some of the fibres of the obturator externus. The deep division gives off:—

1. Muscular Branches to the obturator externus and adductor magnus, and occasionally to the adductor brevis.
2. An Articular Branch to the knee, which pierces the adductor magnus and reaches the back of the joint by passing along the popliteal artery.

Occasionally an **Accessory Obturator Nerve** is present, which arises from the obturator nerve or from the third and fourth lumbar nerves. It leaves the pelvis by passing over the pubis, and joins the superficial division of the obturator nerve, supplying also small twigs to the pectineus and hip-joint.

SACRAL AND COCCYGEAL NERVES.

The first, second, third, and part of the fourth sacral nerves, which pass through the anterior sacral foramina, form with the lumbo-sacral cord the sacral plexus.

The **Fourth Sacral Nerve**, besides supplying an offset to join the sacral plexus, gives **Visceral Branches** to the pelvic viscera, according to the sex; and **Muscular Branches**, which supply the muscles of the pelvic floor—viz., levator ani and coccygeus; and one long branch called the **Perineal Branch**, which pierces the coccygeus, or passes through the interval between that muscle and the levator ani and supplies the external sphincter and integument behind the anus.

The **Fifth Sacral Nerve** comes forward opposite the junction between the sacrum and coccyx, and is joined by a filament of the fourth nerve. It supplies the coccygeus muscle and, along with the Coccygeal Nerve, is distributed to the skin in the region of the coccyx.

The **Coccygeal Nerve** forms, when joined by the fifth sacral nerve (as above mentioned), what is sometimes called the Coccygeal or Sacro-Coccygeal Plexus.

SACRAL PLEXUS.—(Plate IX.)

This plexus is formed by the union of the lumbo-sacral cord with the first three and part of the fourth sacral nerves. These nerves form a flattened band which is somewhat triangular in shape, and lies on the anterior surface of the pyriformis muscle. The plexus is frequently formed of two bands or cords—an upper and larger one, which terminates mainly in the great sciatic nerve; and a smaller cord, which is continued to the pudic nerve. All the branches of the plexus emerge from the pelvis through the great sacro-sciatic foramen, excepting a few twigs which enter the pyriformis within the pelvis.

BRANCHES.—From this plexus the great and small sciatic and pudic nerves arise, and Muscular Branches are given to the pyriformis, obturator internus, gemelli, and quadratus femoris.

Muscular Branches—

The **Pyriformis** is supplied by the upper sacral nerves.

The **Nerve to the Obturator Internus** reaches that muscle by re-entering the pelvis through the lesser sciatic foramen; it also supplies the gemellus superior.

The **Nerve to the Quadratus Femoris** reaches the deep surface of the muscle by passing beneath the tendon of the obturator internus and the two gemelli; it also supplies the gemellus inferior and a twig to the hip-joint.

The **Superior Gluteal Nerve** arises from the lumbo-sacral cord, and leaves the pelvis above the pyriformis, and divides into two branches; the upper supplies the gluteus medius, and the lower, which is larger, supplies the gluteus medius and minimus, and terminates in the tensor fasciæ femoris.

The **Inferior Gluteal Nerve.**—This nerve is sometimes described as a branch of the small sciatic nerve, with which it is connected; it supplies the gluteus maximus.

PUDIC NERVE.

The pudic nerve is derived from the second and third sacral nerves, and having emerged from the pelvis, below the pyriformis, winds round the spine of the ischium to reach the hinder end of the ischio-rectal fossa, where it divides into three branches—viz., inferior hæmorrhoidal, perineal nerve, and dorsal nerve of the penis, or clitoris, according to the sex.

The Inferior Hæmorrhoidal Nerve crosses the ischio-rectal fossa, and supplies the external sphincter muscle and skin near the anus.

The Perineal Nerve divides into superficial and deep branches—

The **Superficial Branches** are the internal and external Superficial Perineal Nerves, which are prolonged forwards to the skin of the scrotum or labium pudendi.

The **Deep Branches** supply the perineal muscles—viz., sphincter ani, levator ani, transversus perinei, as well as the accelerator urinæ and erector penis, in the male, or the corresponding muscles in the female.

SMALL SCIATIC NERVE.

This nerve arises from the second and third sacral nerves, and having received a communicating branch from the inferior gluteal nerve, descends beneath the gluteus maximus, but superficial to the hamstring muscles, and supplies the skin of the back of the thigh, popliteal space, and upper part of the calf.

The small sciatic nerve also gives branches to the skin over the gluteus maximus, and the **Long Pudendal Branch,** or nerve of Sœmmerring, which winds round the tuber ischii to supply the skin of the scrotum, or labium pudendi, and that of the adjacent part of the inner side of the thigh. It communicates with the superficial perineal nerve.

GREAT SCIATIC NERVE.

This nerve commences at the lower border of the pyriformis and is continued down the back of the thigh between the great trochanter and tuber ischii. Before it reaches the popliteal space, it divides into the internal and external popliteal nerves.

At first it lies beneath the gluteus maximus, and is afterwards covered by the long head of the biceps muscle. In the gluteal region, it rests on the obturator internus, two gemelli, and quadratus femoris muscles; and in the thigh lies on the adductor magnus.

BRANCHES.—Besides its terminal branches above mentioned, it gives offsets to the hamstring muscles—viz., semi-tendinosus, semi-membranosus, and biceps; and to the adductor magnus.

INTERNAL POPLITEAL NERVE.

This is the larger of the two popliteal nerves and passes down the middle of the popliteal space as far as the lower border of the popliteus muscle, where it becomes the posterior tibial nerve. At first it lies away from, and to the outer side of, the popliteal artery, but soon becomes superficial to that vessel, and crosses to its inner side.

BRANCHES—

1. **Muscular Branches.**—Branches are supplied to the plantaris, gastrocnemius (two heads), soleus, and popliteus; the branch to the popliteus enters that muscle on its anterior surface, after winding round its lower border, and gives a twig to the tibia.

2. **Articular Branches.**—These are three in number, and accompany the superior internal, inferior internal, and azygos articular arteries.

3. **Cutaneous Branch** (short or external saphenous or ramus communicans tibialis).—This descends between the two heads of the gastrocnemius, and is joined by a branch of the external popliteal nerve (ramus communicans fibularis). The nerve passes behind and below the external malleolus and supplies the skin of the outer border of the foot, terminating in the outer side of the little toe.

POSTERIOR TIBIAL NERVE.

This nerve accompanies the posterior tibial artery, lying first internal to that vessel, but afterwards crosses to its outer side, and terminates between the internal malleolus and the calcaneum, by dividing into the two plantar arteries.

BRANCHES—

1. **Muscular Branches** to the deep muscles of the back of the leg—viz., tibialis postieus, flexor longus digitorum, and flexor longus hallueis.

2. **Plantar Cutaneous Branch,** to the skin of the heel and hinder parts of the sole.

3. **Articular Branches,** to the ankle-joint.

INTERNAL PLANTAR NERVE.

The internal is the larger of the two plantar nerves, and accompanies the internal plantar artery. It supplies offsets to the abductor hallucis and flexor brevis digitorum museles, and cutaneous branches to the skin of the sole. It terminates in four **Digital Branches,** which supply the three inner toes, and the inner side of the fourth toe. From the first digital nerve a branch is given to the flexor brevis hallueis musele, and from the second and third digital nerves twigs are given to the two inner lumbrieal museles.

EXTERNAL PLANTAR NERVE.

This nerve crosses the foot obliquely, lying with the external plantar artery between the flexor brevis digitorum and accessorius museles, and at the base of the fifth metatarsal bone it divides into superficial and deep portions, having supplied offsets to the accessorius and abductor minimi digiti.

The **Superficial Portion** supplies **Digital Branches** to the outer side of the little toe and adjacent sides of the little and fourth toes, and a branch to the flexor brevis minimi digiti.

The **Deep Portion** follows the deep part of the external plantar artery, and supplies offsets to the two outer lumbrieal museles, adductor hallueis, transversus pedis, and all the interossei muscles.

EXTERNAL POPLITEAL NERVE.

The external popliteal or peroneal nerve passes along the outer side of the popliteal space, close to the bieeps musele. It then passes between the biceps and outer head of the gastroenemius, and winds round the upper end of the fibula, passing through the peroneus longus, and divides into musculo-cutaneous, anterior tibial, and recurrent artieular nerves.

BRANCHES.—Besides the above terminal branches it supplies:—

1. **Articular Branches,** two in number, superior and inferior, which accompany the superior and inferior artieular arteries.

2. **Cutaneous Branches,** which supply the skin of the back and outer side of the leg. The largest of these (ramus communicans fibularis), usually joins the short saphenous nerve.

The **Recurrent Articular Nerve** accompanies the anterior tibial recurrent artery to the knee joint.

ANTERIOR TIBIAL NERVE.

This nerve passes beneath the extensor longus digitorum, to reach the anterior tibial artery, along with which it passes down the leg to the ankle, where it divides into internal and external branches. It lies for some distance in front of the anterior tibial artery, but at the ankle it is external to that vessel.

BRANCHES—

1. **Muscular Branches** are supplied to the tibialis anticus, extensor longus digitorum, extensor proprius hallucis, and peroneus tertius.

2. **Articular Branch** to the ankle joint.

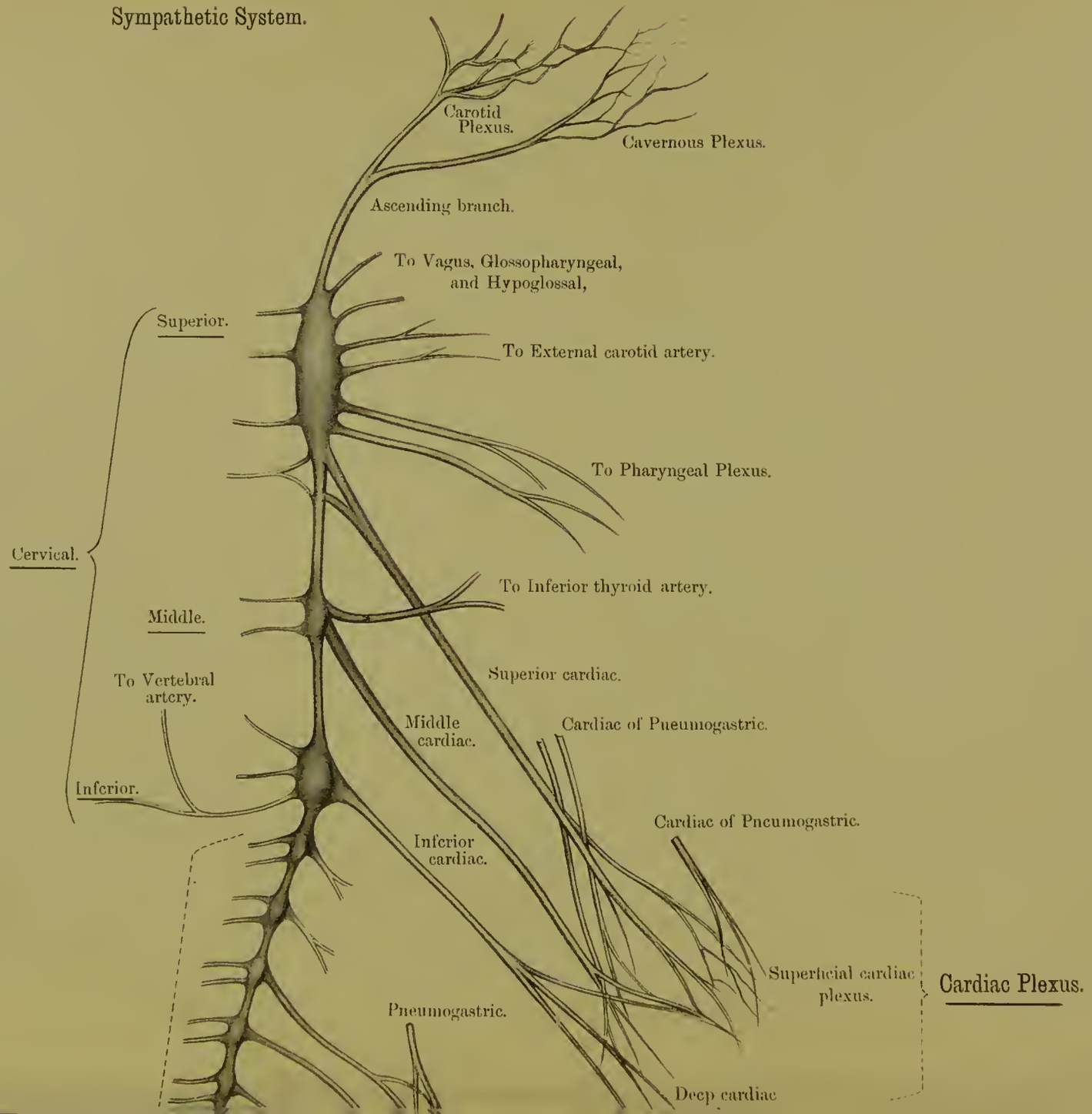
3. The **Internal Branch** is continued along the outer side of the dorsalis pedis artery to the first interosseous space, and supplies the adjacent sides of the great and second toes.

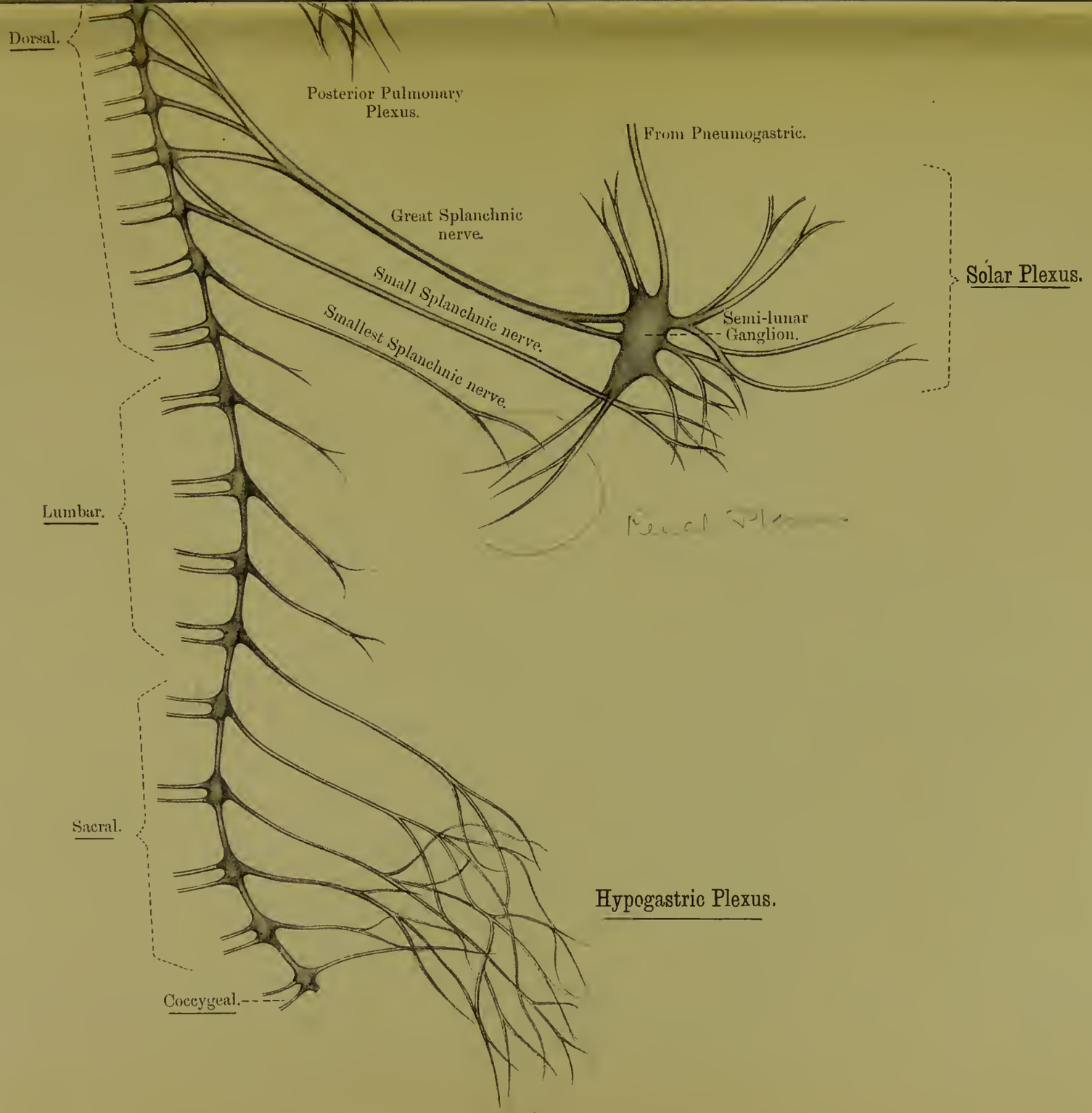
4. The **External Branch** passes beneath the extensor brevis digitorum, beneath which it becomes enlarged, and from the enlargement twigs are furnished to that muscle and the articulations of the tarsus.

MUSCULO-CUTANEOUS NERVE.

This nerve descends between the peronei muscles and the extensor longus digitorum, and pierces the fascia in the lower third of the leg; it passes to the dorsum of the foot and supplies digital branches to all the toes, excepting the outer side of the little toe and the first interspace, which are supplied by the external saphenous and anterior tibial nerves. Muscular branches are given to the peronei muscles (longus and brevis), and cutaneous branches to the front of the leg.

Sympathetic System.




Dorsal.
Posterior Pulmonary Plexus.
From Pneumogastric.
Great Splanchnic nerve.
Small Splanchnic nerve.
Smallest Splanchnic nerve.
Semi-lunar Ganglion.
Solar Plexus.
Lumbar.
Sacral.
Coccygeal.
Hypogastric Plexus.

A. W. HUGHES

SYMPATHETIC NERVES.

(Plate X.)

The sympathetic system consists of two gangliated cords, which lie on the sides of the bodies of the vertebræ, and extend from the base of the skull to the coccyx. The ganglia in general correspond in number to the spinal nerves, but in the neck there are but three ganglia on each side, and inferiorly the gangliated cords approach each other and meet in front of the coccyx in a single ganglion, called the Ganglion Impar or coccygeal ganglion.

Each ganglion supplies *Internal* and *External* branches.

The **External Branches** communicate with the spinal nerves, and contain two sets of fibres, some passing from the spinal nerves to the sympathetic, and others which pass from the ganglia to the spinal nerves.

The **Internal Branches** are distributed to blood-vessels (*nervi molles*), and to the viscera. The branches to the viscera form, with branches of the cerebro-spinal system, large plexuses in the thorax, abdomen, and pelvis; and branches are given from each region to the region immediately below to assist in the formation of a plexus in that region. Thus the cardiac nerves pass from the neck to the thorax; the splanchnic nerves pass from the thorax to the abdomen; and nerves pass from the abdominal ganglia to the pelvis, to form the hypogastric plexus.

Besides the internal and external branches above mentioned, the superior cervical ganglion has branches of communication with the cranial nerves—some of which join the cranial nerves at the base of the cranium; while others pass along the internal carotid artery to the cavity of the cranium, and form there the carotid and cavernous plexuses, with which several of the cranial nerves are connected.

CERVICAL GANGLIA (Three in number).

SUPERIOR CERVICAL GANGLION.

This is the largest of all the sympathetic ganglia, is fusiform in shape, and lies on the rectus capitis anticus muscle, behind the internal carotid artery, and opposite the second and third cervical vertebræ.

BRANCHES—

1. **External Branches** join the four upper cervical nerves.

2. **Anterior Branches** pass to the external carotid artery and form plexuses on the branches of that vessel.

3. Internal Branches—

(*a*) **Pharyngeal Nerves** pass to the surface of the middle constrictor muscle, and unite with branches of the vagus and glosso-pharyngeal nerves, forming the Pharyngeal Plexus, from which branches are supplied to the mucous membrane and muscles of the pharynx.

(*b*) **Superior Cardiac Nerve** — (Each cervical ganglion supplies a cardiac branch, named the superior, middle, and inferior, which are distributed to the cardiac plexuses).—The superior cardiac nerve descends behind the common carotid artery to the thorax, and on the right side enters the deep cardiac plexus; but the left nerve crosses the arch of the aorta to reach the superficial plexus.

4. Superior Branches.—Some of these join the vagus, glosso-pharyngeal, and hypo-glossal nerves, close to the cranium; but one is of large size—viz., the **Ascending Branch.** This accompanies the internal carotid artery through the carotid canal, and divides into an *External Branch*, which forms the Carotid Plexus, on the outer side of that vessel, near its second bend; and an *Internal Branch*, which forms the Cavernous Plexus on the inner side of the artery and anterior to the carotid plexus.

These plexuses distribute filaments on the branches of the internal carotid artery, and communicate with the cranial nerves. The *Cavernous Plexus* communicates with the third, fourth, and ophthalmic division of the fifth nerves, and supplies the sympathetic root to the lenticular ganglion. The *Carotid Plexus* communicates with the Gasserian ganglion and sixth nerves, and furnishes a branch to join the Vidian nerve, and a twig to the tympanic plexus.

MIDDLE CERVICAL GANGLION.

The middle cervical ganglion lies on the inferior thyroid artery, opposite the sixth cervical vertebra.

BRANCHES—

External Branches join the fifth and sixth cervical nerves.

Internal Branches—

1. Some filaments pass along the **Inferior Thyroid Artery** to the thyroid body and larynx.
2. **Middle Cardiac Nerve.**—This nerve passes, on each side, to the deep cardiac plexus.

INFERIOR CERVICAL GANGLION.

The inferior cervical ganglion lies close to the neck of the first rib.

BRANCHES—

External Branches join the seventh and eighth cervical nerves.

Internal Branches—

1. A few twigs are distributed along the **Vertebral Artery** to the cranial cavity.
2. **Inferior Cardiac Nerve.** — This nerve passes to the deep cardiac plexus, and is frequently joined to the middle cardiac nerve.

THORACIC GANGLIA.

These ganglia are twelve in number and lie mostly on the heads of the ribs, but the lower ones lie against the sides of the bodies of the vertebræ. The gangliated cord lies over the aortic intercostal arteries and behind the pleura, but the superior intercostal artery is external to it.

BRANCHES—

External Branches join the twelve dorsal nerves.

Internal Branches—

The **Internal Branches of the upper five or six Ganglia** pass partly to the aorta and vertebral column. Branches are given from the second, third, and fourth ganglia to the *Posterior Pulmonary Plexus*.

The **Internal Branches of the lower six Ganglia** form the three splanchnic nerves, which pass through the crura of the diaphragm to join certain plexuses in the abdomen.

The Great Splanchnic Nerve is formed by branches from the sixth to the tenth ganglia (sometimes from the fifth), and terminates mainly in the semilunar ganglion of the solar plexus.

The Small Splanchnic Nerve arises from the tenth and eleventh ganglia and passes to the cœliac plexus.

The Smallest Splanchnic Nerve arises from the twelfth ganglion and joins the renal plexus.

LUMBAR PART OF THE GANGLIATED CORD.

The lumbar ganglia are usually four in number, and lie on the anterior surfaces of the bodies of the vertebræ, along the inner margin of the psoas muscle.

BRANCHES—

External Branches join the lumbar nerves.

Internal Branches.—Some join the aortic plexus, and others descend to form the hypogastric plexus.

SACRAL GANGLIA.

These are of small size and give off small external branches to join the sacral nerves, and internal branches to the pelvic plexus and the plexus on the middle sacral artery.

PLEXUSES OF THE SYMPATHETIC.

The visceral branches of the sympathetic forms three main plexuses, which lie in the thorax, abdomen, and pelvis—viz., the cardiac, the solar, and the hypogastric with its extensions—the pelvic plexuses.

The CARDIAC PLEXUS is formed by the interlacement of the cardiac branches of the sympathetic and pneumogastric nerves, and consists of two parts—superficial and deep.

The **Superficial Cardiac Plexus** lies in the concavity of the arch of the aorta, close to the ductus arteriosus, and is formed by the left superior cardiac branch of the sympathetic, and the left inferior cervical cardiac branch of the vagus, together with some fibres from the deep plexus. At the point of junction of the fibres is a ganglion—the GANGLION OF WRISBERG.

The **Deep Plexus** lies behind the arch of the aorta, and in front of the bifurcation of the trachea. It is formed by the cervical cardiac branches of the pneumogastric and sympathetic nerves, which do not join the superficial plexus, and the thoracic cardiac branches of the pneumogastric nerves.

The CARDIAC PLEXUSES distribute branches to the coronary and anterior pulmonary plexuses.

SOLAR OR EPIGASTRIC PLEXUS.

The **Solar Plexus** lies behind the stomach above the pancreas and across the aorta and crura of the diaphragm. It surrounds the origins of the cœliac axis and superior mesenteric arteries, and is formed by branches of the pneumogastric, and by the great splanchnic nerves. It contains several ganglia, the largest of which are the semilunar ganglia.

Each **Semilunar Ganglion** lies between the crus of the diaphragm and the supra-renal capsule, and receives the great splanchnic nerve at its upper angle.

The solar plexus distributes branches along the abdominal vessels to the viscera, and these form secondary plexuses, which are named according to the vessels which they accompany—viz., cœliac, renal, phrenic, aortic, superior mesenteric, etc.

HYPOGASTRIC PLEXUS.

This plexus lies in front of the last lumbar vertebra or promontory of the sacrum, between the two common iliac arteries, and is formed by branches from the aortic plexus and lumbar ganglia. At its lowest part this plexus divides into two parts, which are prolonged on each side of the rectum, and being joined by the visceral branches of the third and fourth sacral nerves, form the **Pelvic** or **Inferior Hypogastric Plexuses**, from which branches are distributed to the pelvic viscera.

INSTITUTE OF NEUROLOGY
ROCKEFELLER
MEDICAL
LIBRARY
QUEEN SQUARE

Edinburgh: Printed by E. & S. LIVINGSTONE, 4 Melbourne Place.